Session 1 Sustainable and adapted forest management to the socio-economic system -ORAL PRESENTATIONS -3rd of October 2023

KEYNOTE SPEAKER

Chairs

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Managing forests for multiple purposes in a changing world and under contrasting pressures: can we take the challenge?

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Abstract

Forests have assured the provision of several ecosystem services for centuries. In Europe the concept of multifunctional Sustainable Forest Management emerged in the early nineties of the XX century, building on a long-standing tradition of forest management and planning. Nowadays, forest ecosystems are under pressure from the climate crisis (warming, drought, increase in extreme events, pests and pathogens outbreaks) with potential risks on the provision of services and with effects on the ecosystem processes linked to carbon cycling, with possible impacts on climate change mitigation. At the same time, increased and new demands, as well as new concepts, are emerging on forests and forest resources (e.g. circular bioeconomy, climate-smart forestry, biodiversity-smart forestry, continuous cover forestry, etc.). In this respect, adaptation to future environmental conditions and risks is becoming an urgent issue and a challenge for the forest-wood sector. In these complicated framework conditions, international policies at European Union and global levels are posing new challenges to forest management, with increasing demands for renewable materials while concurrently asking for enhancing the carbon sink role of forest ecosystems and for restoring degraded ecosystems. Also, more protected areas for biodiversity and, hopefully, stop deforestation. In this respect, the successful implementation of the ambitious agreements, frameworks, goals, and targets at European and national level calls for high-quality, up-to-date scientific achievements and innovation drawing on the best expertise. How forest scientists can contribute to find practical solutions in order to respond to the major challenges of society and foster the relationship among scientists, stakeholders, and policymakers? The keynote will provide an overview of the current situation, risks and opportunities for the forest sector while discussing the challenges at stake for forest researchers and forest managers.

Evaluating Forest Management Regimes: Carbon, Biodiversity, and Economic Outcomes

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Abstract

Finland and the European Union aim for carbon neutrality by 2035 and 2050, respectively. Achieving these goals necessitates innovative measures from forests to decrease net greenhouse gas emissions. We examined carbon reduction potential in the forests of Ii municipality, Northern Finland, focusing on carbon storage in living trees, deadwood and soils. The future carbon storage capacity of forests heavily depends on their management. We evaluated several management alternatives, including traditional rotation forestry (BAU) and continuous cover forestry (CCF). We also assessed the impact of these alternatives on carbon storage, biodiversity and net present value (NPV) using available data and models. Using the SIMO simulation, we predicted forest stand characteristics, carbon storage, and biodiversity indicators and NPV for 100 years Our findings suggest that the CCF management regime were more cost-effective i.e., efficiently combines carbon storage, biodiversity, and economic performances compared to BAU management regime. This study also explores how alternative forest management approaches could inform planning and decision-making processes aimed at climate change mitigation.

Keywords

CCF; BAU; Carbon Storage; Biodiversity Indicators; Net Present Value; Climate Change Mitigation.

Assessment of climate change impact on the management of a Protected Area

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Abstract

Climate change is considered one of the important factors that significantly affect the management of protected areas. In the future, the pressures increased by climate change are expected to create an impact on the biodiversity values preserved *in situ* in these managed areas as well as in the processes of different ecosystems. The purpose of this study was to share different perspectives between the community and the park managers in order to have a more collaborative and effective management plan for the study area, Divjakë-Karavasta National Park. We compared the knowledge and perceptions of the community located near the park and the managers of the protected area in relation to climate change and the current management of the park. The results show concerns regarding the changes in the water regime, the rainfall regime (lack of rainfall, intensity, and uneven distribution according to the respective seasons), as well as changes in the temperature regime. There are also concerns from the community about changes in coastal waters from river alluvium, how climate change will affect tourism and recreation, the disruption of function and loss of ecosystem services, and the economic activity of the area.

Keywords

climate change, community, ecosystem, protected area

Pattern of natural dynamic of a sessile oak- European beech old-growth forest

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Abstract

Old-growth forests are often seen as a benchmark of naturalness and an important source of information. Most European forests, especially oak forests, have been intensively exploited. The Runcu-Grosi Natural Reserve, of Western Romania, is one of the few remaining, well-preserved sessile oak-beech old-growth forests in Europe. In the present study, we explore the 10-year dynamics of this rare old-growth forest, based on the re-measurements of approximately 1880 trees with a diameter at breast height greater than 5 cm, grown in 26 circular plots of 1000 m2 randomly distributed throughout the entire reserve. Three important processes of forest dynamics: ingrowth, mortality and increment of trees were investigated, as well as the effect of the main tree species on these processes. The ingrowth, defined as the number of trees per hectare that reached the 5 cm diameter threshold at the second inventory, ranged from 0 to 200 per hectare, with an average value of 63. Beech accounted for 71% of the new trees, followed by hornbeam (24%), while sessile oak accounted for an insignificant percentage (0.02 %). The lowest average number of new trees was found in pure beech plots (25), three times lower than in plots dominated by beech or oak (75), but with no significant differences, due to the high variability. The average number of trees per hectare that died during the last ten years was 113, corresponding to an average volume of 107 m3 ha-1 (17 % of the initial volume of living trees ranged from 0.5 to 50%). Although the percentage of trees that died was almost similar between plots of different compositions, the oak-dominated plots had the greatest volume loss trough mortality in the ten years (19 % compared to only 14% in pure beech plots), indicating that a greater number of larger trees died in the oak-dominated plots. Most of the trees that have died during the ten years are lying dead trees (more than 65% in both number and volume). While beech accounted for 67% of the number of trees that died, the Quercus species accounted for over 50% of the volume. The mean radial increment per 10 years was 2.72 cm, similar in plots with different compositions. Our results provide a valuable basis for understanding the sessile oak – European beech old-growth forest dynamic in a changing climate and will be completed with more information collected in inventory plots of 1 ha.

Keywords

tree ingrowth; tree mortality; tree increment; natural dynamic; mixed forest.

Plant species diversity in relation to forest management. Study case of mixed broadleaf-conifer forests in the Southern Carpathians (Romania)

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Abstract

Introduction: In the last decades there is a high pressure from public society to extend the strictly protected areas to preserve biodiversity. Also close to nature practices are often mentioned although proposals are not always scientifically grounded. As a result, without scientific proof, traditional forest management is seen sometimes as the main threat to forests diversity. In such context, the aim of this study is to document the changes in plant species composition due to silvicultural induced disturbances both at stand level and at landscape level (as a mosaic of stands in different development stages).

Site and methods: To reach the study goals, for a time-for-space substitution, different stand development stages were considered. Therefore, forest stands (both under management and protected) in different stages of development were chosen on the southern slope of Postăvaru Mts., near the city of Brașov. These stages ranged from fresh regeneration, established after the final regeneration cutting, to old forest (over 140 years). To be able to compare the effects of management with those of strict protection, plots were also installed inside a natural forest reserve (in an old stand). In each class six circular permanent plots of 500 m2 were surveyed. Collected data included species, abundance, deadwood (classes of decomposition). Plots and classes were then compared through several indices of alpha, beta and functional diversity. The latter included information on: C-S-R strategy, life forms, leaf types, stem type, dispersal strategy, nitrogen producing, nectar producing, micro-habitat facilitation, eatable leaves, twigs, rhizomes / tubers, fruits.

Results: The results indicate that no class (development stage and/or management type) has absolute supremacy for all analyzed parameters. The youngest stage (i.e., highly disturbed forest environment) was the most diverse in terms of species richness and species turnover, either considering the overall composition or the forest species alone. Even more, sensitive species (as orchids) or some functional species groups (as pollen-, nectar- and fruits/seeds providers) thrive also in closed canopy, dense stands of younger classes (1-20 years old). Model simulation of the proportion of various development stages inside the landscape showed that increasing the share of old forest stage did not lead to an increase in plant species diversity (but indeed has led to a significant decrease).

Conclusions: As already found in other studies around the world, species diversity is an indicator of disturbance rather than of conservation status. Moreover, the origin of disturbance does not seem to be a factor which is causing different outcomes (i.e., silviculture does not always lead to fully artificial compositions). However, as none of the stages includes all possible species, it can be concluded that a forest with a mosaic of stands in all development stages are rather richer in species than a homogenous landscape covered by the same development stage (even if it is the old forest). Without neglecting the role of old pristine forests, it must be accepted that proper forest management is a tool to promote and preserve plant biodiversity in the long term in forested landscapes.

Keywords

species diversity; forest management; mixed forest;

Sustainable Forest Operations and battery-powered chainsaws: a good solution for the next future?

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Abstract

One of the main objectives of Sustainable Forest Operations is to guarantee convenient, high-quality and fair productions, protecting the environment, the health and safety of forest operators. In this context, despite the average increase of mechanization level in forest harvesting, the use of chainsaws is still very common in many areas, including large parts of Europe. The use of this tool, in comparison with big machines, guarantees several advantages related with reduced costs, good efficiency and versatility. On the other hand, the use of chainsaws is very dangerous, being the direct or indirect cause of many accidents and the cause of several work-related diseases. In the last years, the technological level of chainsaws increased, including electronic control units and electronically controlled fuel injection. Moreover, a new category of chainsaws appeared for the professional sectors: electric-powered chainsaws with battery. At the beginning, the introduction of battery technology was limited to small and non-professional tools, but in the last years the performances of batteries in terms of both power and autonomy were strongly improved. In fact, considering the same engine power, the best chainsaw producers started to put on the market battery chainsaws declaring the same characteristics and performance of petrol chainsaws. Looking at their potential use in forestry, battery chainsaws could guarantee several advantages in comparison with petrol-powered ones, such as no emissions of exhaust fumes, reduced emissions of both vibration and noise. The objective of this contribution is to understand the real potentiality of battery-chainsaws in real forest operations. The performance in terms of productivity, vibrations and noise emissions, considering also the technical efficiency and comfort in use for forest operators were investigated. Two of the newest models of battery-chainsaws on the market were used in the study and compared with their correspondent petrol-powered model. Regarding vibration and noise exposure, battery chainsaw was tested on beech and black pine logs, according with EU Directive 2002/44/CE. The results showed that there are no statistical differences between battery- and petrol-powered chainsaws in terms of productivity, while the vibrations and noise emissions are very lower. In this sense, the battery chainsaws could theoretically be used in forest operations, but in practical it is not currently possible due to battery duration and recharging. In fact, the duration of a battery is almost the same of a full tank of gasoline, but a forest operator normally needs about 10 full tanks/batteries per day. Being currently difficult to charge batteries in forest, the possibility to use battery-chainsaws is currently limited in forestry. In conclusion, the introduction of battery-chainsaws in forest operations could be a step forward aiming at sustainable forest operations, especially regarding health and safety of forest workers, but it needs to be technically improved in recharging process.

Keywords

Battery technology; emissions; health & safety; forest operations; sustainability.

Assessing the potential for carbon sequestration in various forest management approaches within the Piatra Craiului National Park

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Abstract

The focus on climate change mitigation strategies has raised concerns regarding forest land use management. While the beneficial role of forests in reducing greenhouse gases and storing carbon is well known, insights from sustainable forest management highlight the potential synergy between carbon stock and the provision of forest ecosystem services, such as wood supply. This study, conducted in a national park located in the Southern Carpathians of Romania, compares historical management practices in terms of carbon stock and wood supply while also forecasting the synergies and trade-offs by projecting carbon stock and wood supply ecosystem services for the next 50 years under different management scenarios. By utilizing stand data from forest management plans and analyzing it using the EFISCEN model, three distinct scenarios for forest evolution over the next 50 years were generated. These scenarios varied in harvest intensity: the first scenario represented the Business As Usual (BAU) approach, the second scenario involved Maximum Intensity (MAX) harvest, and the third scenario explored a No Harvest (MIN) strategy. The research indicated that considering the current age class structure, the most suitable scenario for the next 50 years in the case study area is the BAU approach. Under this scenario, the forest's growth stock increased from 2.6 million cubic meters to 3.8 million cubic meters, representing a substantial 50% growth over the next 50 years, while annual carbon stock changes revealed higher values in the long term compared to the conservation scenario. Furthermore, the study revealed that non-intervention or long-term conservation does not necessarily lead to higher carbon stocks due to factors like increased mortality and decreased yield. Therefore, actively managing forests through sustainable practices is crucial to achieving optimal results in mitigating climate change. These findings emphasize the importance of strategic forest management as a viable solution for reducing greenhouse gas emissions and combating climate change.

Keywords

climate change mitigation strategies; forest land use management; carbon stock; EFISCEN model; sustainable forest management

Exploring Non-Destructive Methods for Estimating Annual Carbon Sequestration in Mature Coniferous Stands: A Case Study Conducted in Experimental Sites of INCDS 'Marin Dracea' Forests

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Abstract

Carbon sequestration in forest ecosystems is influenced by various factors such as climate, soil conditions, species composition, and management practices. The living biomass pool, which contributes to the formation of deadwood, litter, and soil organic matter, plays a crucial role in the carbon cycle. Despite the complex dynamics and dependencies of carbon stored in dead matter pools, general and empirical relationships can offer approximate estimates based on carbon stored in living biomass. To make the estimation of carbon stored in forest ecosystems more accessible for forest owners and to support ongoing climate change mitigation efforts, it is important to have accurate, standardized, and cost-effective procedures in place that are efficient in terms of time and cost. This study estimates the carbon stock in living biomass and investigates the feasibility of non-destructive techniques for estimating annual carbon sequestration in mature coniferous forests in Romania. Specifically, the study aims to determine mean annual growth and tree density using a drilling resistance measuring device known as the Resistograph. The Resistograph utilizes a needle-like drill bit to penetrate the tree trunk, measuring the resistance encountered during drilling and generating a graphical resistance profile that indicates changes in resistance with depth. As a non-destructive tool, the Resistograph creates small drill holes that can be easily sealed, minimizing any potential harm to the trees. The study was conducted in a coniferous stand consisting of equal proportions of Norway spruce (*Picea abies* L., H. Karst) and Silver fir (*Abies alba* Mill) species, with a homogeneous age of 120 years. The research site covered an area of approximately 10 hectares, characterized as a "Norway spruce mountain, large and medium edaphic brown with Oxalis Dentari+/- acidophilic" (Romanian classification), situated at an altitude of 900 m a.s.l. The sampling design comprised 20 circular plots, each measuring 500 square meters, with a total of 322 trees sampled. From this, 48 trees were selected for both classical increment core extraction and Resistograph measurements. The research objectives were to: (1) compare the Resistograph and standard dendrological method of radial growth measurements, (2) compare wood density obtained by micro drilling with the classical method of determining dry mass over the volume of increment cores, and also (3) estimate carbon stock and annual carbon stock change in mature coniferous stands. Our study observed a significant correlation between annual ring growth measured using the Resistograph and the classical method. Specifically, we found a coefficient of determination (R^2) of 0.839 for Silver fir and 0.879 for Norway spruce when comparing the average values of the last 10 years of growth. However, as we examined the mean values for each successive 10-year interval of growth, particularly beyond 50 years, the coefficient of determination showed a decreasing trendline. This indicates that as the resistance of the microdrill increases, it becomes more challenging to accurately identify each tree ring, resulting in less precise measurements. For our second objective, the average density values obtained through classical methods for oven-dried samples were 0.373 g/cm^3 for Silver fir and 0.347 g/cm^3 for Norway spruce. We observed a satisfactory correlation (R^2 = 0.96) between the sum of drilling resistance measurements and the core samples' dry mass, allowing for generalized linear regression to predict

tree species density. The coefficient of determination between measured tree density and predicted density based on drilling resistance measurements was R^2 = 0.64. Overall, the estimated carbon stock in the study area was 309 tC ha^{-1}. However, this result was slightly underestimated by a difference of 12 tC ha^{-1} when using tree density estimated by the Resistograph. The annual carbon stock change was overestimated by 0.14 tC $ha^{-1}yr^{-1}$ using non-invasive measurements of tree growth and density differences amounting to 1.13 tC $ha^{-1}yr^{-1}$, against 0.99 tC $ha^{-1}yr^{-1}$ for the classical measurements. In conclusion, the usage of the Resistograph shows promising results as a non-invasive tool for assessing annual carbon sequestration in coniferous forests. However, further validation and refinement are needed for accurate carbon stock estimation in forest ecosystems.

Keywords
resistograph, tree growth, tree density, carbon stock, fir, spruce.

Capitalizing on the vegetation conditions for the stands in the forestry fund of the Forestry Entity Strășeni

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Abstract
In Republic of Moldova, the increasing of third and fourth coppice stands, with a special remark on oaks, requires new studies about how the vegetation conditions will by the resort as well as the chosen species in the future exploitation - regeneration works. In the present study, comparative research was carried out on stand provenance, vegetation conditions and stand productivity for forests in the Central Bassarabian Plateau area. Species composition, stand productivity, soil and forest types were studied to establish the correlation between vegetation conditions and current stand structure. As a result, it was found that the analyzed stands do not fully use the vegetation potential (e.g. naturally underproductive fundamental stands, fully derived stands, etc.). The comparative analysis has shown a pronounced gap between vegetation conditions and stand productivity. In this respect, there are 47% of stands with lower productivity, and vegetation potential offers only 3%. The use of vegetation condition potential by stands must be achieved through the correct implementation of management measures.

Keywords
vegetation conditions; stands; tree; system; structure; forest, forestry.

The productivity of Norway spruce (*Picea abies* L.) stands installed using different planting schemes in the north of the Eastern Carpathians

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Abstract

Several factors can influence the productivity of artificial Norway spruce stands, and one of them is the planting scheme (Allen et al. 2021). The research material, was conducted in an experimental plot, with four planting variants (V1 - 2500 trees·ha^{-1}; V2 - 3330 trees ·ha^{-1}; V3 - 5000 trees ·ha^{-1}; V4 - 7510 trees ·ha^{-1}), in the northern Carpathians, age 45 years. Research issues related to some productivity indices, dominant height and presence of disturbance factors in artificial Norway spruce stands. The obtained results showed that the average increases of the main productivity have the highest value in the V2 variant with m^3·ha^{-1} with a volume per hectare of 767 m^3, and the smallest increase was in the V4 variant with 14.4 m^3·ha^{-1} with a volume per hectare of 606.9 m^3 (Vlad et al. 2023). Regarding the dominant height, a superiority of variants using a small number of trees in the planting scheme (V1 and V2), unlike variants with a high number of seedlings in the planting scheme (V3 and V4). The main injuries found in the experimental areas were: injuries caused by deer, exploitation injuries and damage by wind.

Keywords

Norway spruce; productivity; net primary productivity; injuries.

Adaptation of Life cycle assessment for torrent control structures

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Abstract

Mountain areas are prone to the occurrence of extreme events, especially torrential floods, accentuated as a result of climate and environmental changes. Considering the high vulnerability of our country to the occurrence of extreme events, there is a need for proactive management, which will increase the resilience and adaptability to environmental changes and will guide decision-makers in adopting effective measures. In this context, effective torrent control structures that reduce the vulnerability and exposure risk of human communities are mandatory. The field of constructions, which also includes torrent control structures, has an outstanding importance in achieving climate neutrality and resource sustainability. The torrent control structures reduce the torrential risks either by limiting the causes or by diminishing their consequences. Life cycle assessment (LCA) is considered a decision support tool for achieving environmental sustainability. LCA is a standardized, integrated and useful method that allows the evaluation of the environmental impact on the entire lifetime of a product or process. At the watershed scale, the purpose of LCA analysis is to determine the cumulative impact of extreme events and the progressive degradation of torrent control structures enabling at the same time an improved understanding and quantification of the environmental impact of infrastructure and processes. Therefore, this methodology is a useful tool for guiding towards more sustainable construction practices. Unfortunately, the use of this tool for water resource management is still limited. Moreover, the LCA for torrent control structures will provide the qualitative and quantitative criteria required by the DNSH (Do no significant harm). Besides, the LCA will contribute to a more accurate assessment of the environmental impact of the torrent control structures both during the construction period and during the normal operation period.

Keywords

life cycle assessment; torrent control structures; decision-support tool; environmental sustainability

Health state and behavior of pine stands on degraded lands in the Vrancea Subcarpathian site

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Abstract

The reference forestry cultures were made in successive stages on lands with difficult conditions (lack of fertile soil horizon, steep slopes) through specific land preparation and afforestation technologies, with appropriate compositions and schemes. The cultures perform special protective functions intending to reduce soil erosion, consolidate eroded slopes and protect some objectives of social interest. The paper presents the results of research regarding the health state of Scots pine stands (*Pinus sylvestris* L.) on degraded land in relation to species, age, intensity of degradation and the nature of abiotic factors. The research was carried out in two representative improvement perimeters (Caciu-Bârsești and Pârâul Sărat-Valea Sării) in the Vrancea Subcarpathian site. From the analysis of the results, the structure of the stands is non-conforming and atypical to the stands with an even-aged structure, against the background of injuries caused by different abiotic factors (wind and snow), the failure to apply adequate silvotechnical works on time and insufficient self-regulation. It was found that young Scots pine stands have a greater vulnerability to defoliation, the average degree of dryness (*Gu*) being more pronounced than in old stands (*Gu-total*=1.99). From the point of view of injury, the Scots pine stands recorded quite frequent falls and breaks, the degree of injury (*Gv%*) having a moderate intensity (15.61-16.67%). Alteration of the health state of stands over time leads to a decrease in the stability of the ecosystem, with negative ecological and economic consequences. The incapacity of resilience of these stands produces dysfunction in the way of organization and modeling of the structure, but also in the triggering of the stages of the succession. The obtained results are useful for the scientific substantiation of silvotechnical management and regeneration of forestry ecosystems on degraded lands, in order to ensure the special functions and assigned management goals.

Keywords

average degree of dryness; defoliation; degree of injury; Scots pine; degraded lands.

Analyzing Carbon Sequestration Potential in Peri-Urban Deciduous Forests Under Different Land Use, Land Use Change and Forestry Management Approaches

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Abstract

Forests ecosystems play a critical role in mitigating the adverse effects of climate change through their ability to reduce atmospheric carbon dioxide levels and store it as carbon in living tree biomass, as well as in dead matter such as deadwood, litter, and soil. Nevertheless, forest ecosystems not only absorb carbon but also emit greenhouse gasses, depending on various factors such as forest management and forest land use conversion practices. The conversion of forested land to other land uses represents the most significant threat to the Land Use, Land Use Change, and Forestry (LULUCF) sector's carbon balance, as most of its carbon is held in soils, with a reduced part being stored in vegetation. In this context, understanding the impact of silvicultural and land use management practices on carbon sequestration has recently become of paramount importance. Through this study, we aim to explore the importance of carbon sequestration in peri-urban forests and the potential impact of various management scenarios on carbon storage. These scenarios include historical silvicultural interventions such as non-silvicultural intervention (NSI), low silvicultural intervention (LSI), and high silvicultural intervention (HSI). The study goal was to (1) evaluate and compare the impact of forest management practices on carbon stock and (2) quantify the annual sequestration capacity of each site. Our study emphasizes the critical role that management as silvicultural interventions but also including land use management, can play in enhancing carbon sequestration and reducing greenhouse gas emissions. We analyzed the carbon stock and removal for each carbon pool, including aboveground biomass (AGB), belowground biomass (BGB), dead organic matter (DOM), and soil organic carbon (SOC), based on inventory data in an oak genus species (i.e., sessile oak and turkey oak) peri-urban forest site located near Orastie City. The study site covers an area of forest vegetation of 40 ha, for which due to changes in property ownership over the last 30 years, different forest management practices were applied to the initial even-aged 90-year-old forest, in 1990, resulting in three different forest stand types. One site was deforested, abandoned and naturally regrown during this period (NSI); at another site, the crown cover was strongly reduced to create space for natural regeneration (HSI); and the last site preserved the business-as-usual forest stand management (LSI). In each stand, tree biometrics, litter, and soil samples were collected in statistical field plots for further processing of carbon stocks. The results indicate a strong relationship between forest management and the average carbon stock of forest stands. We found that the overall carbon stock, stored in all pools (AGB, BGB, DOM, and SOC), in the young unmanaged forest stand - NSI (i.e., stand age almost 30 years) represented almost 77% of the carbon stock in the HSI site and only 19% of the carbon stock in the LSI site. Based on carbon pool determinations, the LSI site recorded the highest carbon stock (250.9 tC ha^{-1}), due to the contribution from biomass (AGB and BGB), characterized by large live trees. In contrast, for DOM pools (deadwood and litter stocks), the NSI site recorded the highest carbon value (9.4 tC ha-1), probably because of high mortality rates due to the high tree density (i.e., small live trees) on the one hand and competition for nutrients and light on the other hand. Additionally, no significant differences were recorded between sites for SOC stocks (the mean value recorded

for all sites being 92.3 tC ha^{-1}). Regarding our analysis of carbon stock changes in tree biomass, the lowest value was recorded for the HSI site (0.28 tC yr^{-1} ha^{-1}) and the highest value was recorded for the NSI site (2.01 tC yr^{-1} ha^{-1}), highlighting the substantial potential for carbon sequestration of the latter. The main result observed shows the potential of forest ecosystems, even in the worst-case scenario of deforestation at one point in time, to naturally recover and maintain their function of carbon sequestration, especially if the land use (i.e., forestland) remains unchanged. Additionally, we found that the non-intervention site (NSI) can act as a net carbon sink, with the highest annual carbon sequestration potential among all three sites, under the condition that no silvicultural interventions were carried out in the last three decades. Overall, the study emphasizes the importance of forest conservation and sustainable management as an effective strategy to reduce carbon emissions and demonstrate the potential of peri-urban forests to sequester carbon towards achieving emission reduction targets.

Keywords
carbon sequestration; above ground biomass; belowground biomass; dead organic matter; soil organic carbon; forest management.

Wood density and biomass allocation for European beech (*Fagus sylvatica* L.) in central Romanian forest

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Abstract
Forest carbon stock estimation has a particularly high importance in addressing the challenges posed by climate change. Considering the ongoing activities such as land use change and deforestation onto the carbon cycle it becomes necessary to understand the amount of carbon stored in the forest. Accurate carbon stock estimation not only helps to assess the impact of these activities on carbon emissions, but it also serves as a crucial tool in designing and implementing effective policies aimed at reducing greenhouse gas emissions and promoting carbon sequestration and also can help outline a frame as clearly as possible in the upcoming climate scenarios. Determining mean wood density (WD) and biomass of tree parts by destructive methods could be challenging and time-consuming but with important implications in forest carbon accounting because the mean wood density of trees has great significance in estimating aboveground biomass (AGB) and finally the carbon stock. For a better understanding of forest carbon storage in different components of trees, it is important to know the WD variation along the stem as well as species-specific WD values. The aim of the current study is to estimate WD and tree component biomass for European beech (*Fagus sylvatica* L.), a species with the greatest importance in Romania both economically and ecologically. More precisely, the objectives of this study were (1) to evaluate the most

accurate method for determining the WD of trees in the context of carbon stock evaluation; (2) to assess the allocation of AGB per each tree component; (3) to assess how WD varies along the stem of trees. The aboveground biomass was evaluated using the destructive method and trees were selected to cover a large range of diameters at breast height (DBH), from 16.8 to 56.5 cm. A total number of 17 European beech trees were analyzed in a single tree selection system managed forest stand. 172 sample parts of disks were collected at different lengths along the stem from the base of the tree to the top (diameter < 5 cm) as well as from branches (50 samples) for three thickness categories: smaller than 5 cm, between 5-12 cm and between 12-20 cm. The average wood density of each tree was determined as a volume-weighted average for each section which incorporated the average density of end-sections and their corresponding volumes. Trees were categorized into three distinct classes based on their DBH: small trees, measuring less than 30 cm in diameter; medium-sized trees, ranging from 30 to 40 cm in diameter; and large trees, exceeding 40 cm in diameter. Our results showed that for stem WD was 569.2 kg/m3 (SD ± 31.4, n = 172) while for branch WD was 597.5 kg/m3 (SD ± 39.8, n = 50). As regarding the variation pattern of density along the stem seems to have a steady trend. The proportion of stem biomass from total AGB increased from small diameter (66.8%) class to higher classes (80%) while the proportion of branches presented an opposite tendency (from 30% to 18%). In terms of branch categories, the biomass allocation for branches smaller than 5 cm decreased with increasing diameter classes from 29.2% to 9.7%. This study provides a robust analysis of tree components and total biomass over European beech trees as well as useful information in determining WD, which can be developed using the same sampling method for other species. Also, it shows that there is significant variability in WD and biomass among different tree parts, with the highest values found in the branches followed by stem densities.

Keywords
wood density; Fagus sylvatica; stem; branch; aboveground biomass.

Virgin and quasi-virgin forests from Romania

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Abstract

Many terms have been used to describe the specific characteristics of certain areas of forest where the anthropogenic factor has not intervened, such as: natural, near and semi-natural forest, undisturbed, virgin forest, pristine forest, primeval forest or as in Great Britain and USA, ancient, secular forest. Virgin forest is defined according to the Food and Agriculture Organization (UN-ECE/FAO 2000) as "forest developed under natural conditions and undisturbed by human activities".

The largest area with virgin and quasi-virgin forests in the European Union, respectively two thirds, is found in Romania, which is mostly made up of deciduous forests.

The identification of virgin and quasi-virgin forests started in 2012, based on Order no. 3397/2012. Following the inventory carried out starting from 2016 to 2022, virgin forests were identified on the surface of 24 counties. According to the latest results, there is a total area of 71,077.44 ha, of which 8,579.8 ha are virgin forests and 62,497.64 ha are quasi-virgin forests. The largest share of virgin forests is in Caraș-Severin and Gorj counties, representing 25.5% and 16.5% respectively of the total area with virgin forests in the country.

The largest area with virgin forests is public property of the state (53481.97 ha) and public UAT (Territorial Administrative Units - 5310.72 ha). The most widespread virgin forest types are beech forests (51%) and spruce and mixed spruce forests (38%).

Virgin forests represent a natural heritage of inestimable value and concern for their existence and protection should be permanent. The continuous research of these unique forest ecosystems is a priority both at the national and international level, especially through the need to deepen the understanding of the principles that determine their stability and functionality.

Keywords

protected area; ecosystem; inventory; virgin forests; quasi-virgin forests.

Forest and ecology of communication: directors, actors and laypeople

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Abstract

Whatever analysis carried out on a social or economic setting is incomplete without a thorough analysis of its internal communication. Beyond the fact that such theme is spectacular by definition, being hosted by social media (hence, bearing lots of asymmetries), auditing the internal communication of system allows a better understanding of the real intentions of those who actually play on the market. By market we understand, in addition to the classical definition, the virtual space where all neoliberal concepts fight each other, thus creating a sort of virtual competition, with completely different stakes and interests. Laypeople, brought on this new stage, are buying and selling news and spare pieces information, which resemble, more or less, the bites of nutrients spread over a food chain. Therefore, analyzing the fairness of those who sell or buy perceptions about forestry and forest is worthwhile endeavor and the main end of this communication is to figure out fair and unfair asymmetries delivered on social media networks. We eventually typified four types of communicators, according to the classical scheme of a contingency table: those who deliver falls positive, false negatives, true positives and true negatives; we also developed appropriate communication schemes, able to increase the amount of truth circulating through social media, by showcasing some examples where laypeople opinion on the multiple dimension of forest sustainability converged.

Keywords

information asymmetry; social media; communication; sustainable forestry.

Session 2 Climate change and air pollution effects on forest ecosystems status -ORAL PRESENTATIONS - 3rd of October 2023

KEYNOTE SPEAKER

Chairs

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Strategic roadmap to assess forest vulnerability under air pollution and climate change

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Abstract

Although it is an integral part of global change, most of the research addressing the effects of climate change on forests have overlooked the role of environmental pollution. Similarly, most studies investigating the effects of air pollutants on forests have generally neglected the impacts of climate change. We review the current knowledge on combined air pollution and climate change effects on global forest ecosystems and identify several key research priorities as a roadmap for the future. Specifically, we recommend (1) the establishment of much denser array of monitoring sites, particularly in the South Hemisphere; (2) further integration of ground and satellite monitoring; (3) generation of flux-based standards and critical levels taking into account the sensitivity of dominant forest tree species; (4) long-term monitoring of N, S, P cycles and base cations deposition together at global scale; (5) intensification of experimental studies, addressing the combined effects of different abiotic factors on forests by assuring a better representation of taxonomic and functional diversity across the ~73,000 tree species on Earth; (6) more experimental focus on phenomics and genomics; (7) improved knowledge on key processes regulating the dynamics of radionuclides in forest systems; and (8) development of models integrating air pollution and climate change data from long-term monitoring programs.

Detection of morphological and eco-physiological traits of woody species to improve the removal of air pollutants by urban forests

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Abstract

Urban forests can improve cities air quality by filtering the main atmospheric gaseous pollutants (O_3, NO_2) and particulate matter (PM) through their canopies. However, pollutant removal capabilities offered by woody species strongly depend on trees morphological and eco-physiological traits. Indeed, species with high stomatal conductance (gs) are able to remove more harmful gases from the atmosphere as well as leaf traits (e.g., phyllotaxis) and crown dimensions have an influence on PM deposition. On the other hand, some woody species can even worsen air quality by emitting biogenic volatile organic compounds (bVOCs) precursors of both O3 and PM. However, in the scientific literature, there is a lack of data relating to eco-physiological (gs, bVOCs emissions) and foliar traits for some ornamental woody species not allowing to evaluate their ability to remove pollutants. Therefore, the aim of this study was to assess still unknown values of gs and bVOCs emissions for ornamental woody species (trees and shrubs) commonly used in urban environments. In order to parameterize the gs, 300 measurements under different environmental conditions (light, temperature, vapor pressure deficit, and soil water content) were performed in potted plants hosted in the Pistoia nursery district (43°54'N, 10°41'E) by using a porometer (LI600, Li-Cor, Lincoln, USA). Conversely, foliar emissions of isoprene and monoterpenes were trapped in adsorbent cartridges positioned at the end of the air flow leaving the infrared gas analyzer cuvette (LI6800, Li-Cor, Lincoln, USA) and aspirated by an external pump (AP Buck pump VSS). Quantification and characterization of VOCs were determined in the laboratory by gas chromatography. Our results suggested that *Catalpa bignonioides* and *Gleditsia triacanthos* could have excellent NO_2 and O_3 removal capacity thanks to their high maximum gs equal to 0.657 and 0.597 mol H_2O $m^{-2}s^{-1}$ respectively, while lower values were found for *Parrotia persica* (0.174 mol H_2O $m^{-2}s^{-1}$) and *Ostrya carpinifolia* (0.167 mol H_2O $m^{-2}s^{-1}$). Regarding bVOCs, we found high isoprene (16.75 µg $gdw^{-1}h^{-1}$) and monoterpene (13.12 µg $gdw^{-1}h^{-1}$) emission rates for *Rhamnus alaternus* and *Cornus mas* respectively, while no bVOCs were detected for *Camellia sasanqua* and *Paulownia tomentosa*.

Keywords

urban greening; bVOC emissions; air pollutants; stomatal conductance; urban forestry.

Air quality in European forests - nitrogen compounds trends in the ICP Forests level II network

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Abstract

Nitrogen compounds, and, subsequently, their effects on forests were and still are of concern for the scientific community, policy makers and general public. Ammonia is an important component· of the nitrogen cycle but can also one of the most important greenhouse gases. Agricultural activities such as livestock farming and fertilizer application are the main sources of atmospheric ammonia emissions. ln Europe, ammonia concentrations are highest in agricultural regions, particularly in the summer months during manure spreading and fertilizer application. Nitrogen dioxide is primarily emitted from burning fossil fuels, particularly in transportation, being associated with respiratory problems and can lead to the formation of ground-level ozone. ln Europe, nitrogen dioxide concentrations are highest in urban areas. In the ICP Forests Level II network, air quality (ozone, nitrogen dioxide, ammonia, sulphur dioxide), is assessed both by active and primarily by passive monitoring. The aim of our study is to explore (1) How does nitrogen dioxide and ammonia concentrations vary during the year at plot/country/biogeographical region level? and (2) Is there a temporal trend in nitrogen dioxide and ammonia concentrations at plot/country/biogeographical region level? We will assess long-term trends in nitrogen dioxide and ammonia from more than 150 forest monitoring sites from 16 countries across Europe, and results will be presented and discussed.

Keywords

forest monitoring; level II; ammonia; nitrogen dioxide; air pollutions trends.

Seasonal variation in particulate matter accumulation and element composition of tree species across urban-to-rural land uses

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Abstract

Air pollution, particularly in urban areas, is a critical issue with harmful effects on human health. The presence of solid and liquid particles, known as particulate matter (PM), poses a notable hazard. Of particular concern are fine and ultra-fine particles, as they possess the ability to penetrate the human body. Toxic elements emitted by human activities further exacerbate the problem. Urban trees play a vital role in reducing air pollution by acting as natural filters. However, different plant species vary in their effectiveness in mitigating pollution. This study aims to establish baseline pollutant levels, and classify plant species based on their capacity for PM accumulation and its elements composition, to identify those best suited for pollution mitigation. The study was conducted in the province of Lucca, Italy, with four territory types: urban traffic (UT), urban background (UB), industrial (IND), and rural (RUR). AirQino air monitoring stations measured particulate matter (PM) concentrations. Thirteen plant species were sampled and analyzed for PM accumulation on leaves using the filtration method based on three different filters with different retention capacities: retention > 10 µm (PM10), retention > 2.5 µm (PM2.5), and PTFE membrane – retention > 0.2 µm (PM2.0). The leaf traits as leaf area; leaf perimeter, leaf dissection index; leaf roundness; leaf mass per area and the element composition of PM was also determined Mo, Mg, K, Ca (lower toxicity) Ba, Cu, Fe, Mn, Ni, Pb, Zn, Cd, Co, and Cr (higher toxicity). Statistical analyses, identified representative species and assessed PM deposition patterns. Linear regression analysis examined the relationship between PM in air and PM accumulated and the elements composition on the leaves. The analysis revealed that total PM accumulation varied significantly between territory types and seasons. PM accumulation was always higher in the winter season compared to the summer season. During the winter season the highest values of PM10 was found in UT, while the lowest was observed in IND. During the summer season the highest values of PM10 were recorded also in UT and no significant differences were observed for other territories. Eleven species were identified as having higher capacity for accumulating PM10 (*A. saccharinum, E. japonicus, L. lucidum, L. nobilis, N. oleander, O. europaea, P. laurocerasus, Photinia x fraseri, P. tobira, Q. ilex* and *R. ulmifolius*) while eight species were suitable for accumulating PM2.5 and PM0.2 (*A. saccharinum, L. lucidum, N. oleander, O. europaea, P. laurocerasus, Photinia x fraseri, R. ulmifolius* and *T. jasminoides*). Regarding the PM element composition, Ca and Mn showed the highest accumulation in UT during the winter season whiling the lowest values were observed in the rural areas during the summer season. Ba, Fe, and Zn demonstrated variations among territory types. *L. nobilis, Photinia x fraseri, O. europaea, Q.*

ilex, and *N. oleander* were selected as species with notable element accumulation patterns. Among the leaf traits analyzed, only the leaf dissection index (LDI) showed a negative correlation with PM accumulation. Linear regression analysis indicated that L. nobilis and O. europaea were suitable for reflecting air pollution based on PM10 values. Positive regression was observed between PM2.5 and PM0.2 for *L. nobilis, O. europaea, N. oleander, M. grandiflora,* and *P. laurocerasus*. In summary, the study identified species with higher PM accumulation capacity and assessed the seasonal element accumulation patterns in different territory types. Leaf traits and linear regression analysis provided insights into the species' interactions with particulate matter and their potential for monitoring air pollution.

Keywords
air pollution, mitigation, plant species, leaf traits, monitoring

The results of 20 years of forest condition monitoring as a milestone for future improvement and harmonization

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Abstract
Forest condition monitoring under the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) is one of the world's largest biomonitoring networks. In this paper, we present the results of 20 years of forest condition monitoring in Serbia. As methodological background, we use Manual for visual assessment of crown condition and damaging agents. Assessment was performed on 130 sample plots Level I in 16 x 16 km grid and 4 x 4 km. Results present crown defoliation and tree damage from biotic and abiotic agents. Defoliation is analyzed and compared by tree species, age classes, elevation, and forest management practice. Influence on forest conditions was tested relative to (extreme) meteorological parameters. Detail analysis of biotic and abiotic damages was presented. The results have provided a chronological analysis of the crown condition and determination of main stressors.

Keywords
forest vitality, defoliation, ICP Forests, biotic/abiotic agents, stressors

Changes in climate extremes over the forest types of Romania (1961-2050)

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Abstract

A forest type (FT) generally describes a category of forest defined by its composition, and/or site-specific factors, and used in a system suitable to the situation at country level. The FTs are recognised to be a flexible approach to support the collection of data and organise forest indicators in a given area at different spatial scales, from the management and country up to continental level. The ongoing climate change is associated with increased intensity, duration and spatial extent of the extremes which may exacerbate the impacts on many ecological systems and socio-economic sectors, including the forest ecosystems and forest management. This study explores the observed variability (1961-2020) and estimated changes (2021-2050) in the climate extremes that may occur over the Romania's FTs (RFT), to provide a country-scale perspective of the potential impact on the forest ecosystems and support the informed forest management. Both temperature and precipitation CLIMPACT extremes indices relevant for forestry described and proposed by the Expert Team on Sector-Specific Climate Indices (ET-SCI) were computed using in situ measurements from the national meteorological network and model outputs corresponding to climate change projections based on two Representative Concentration Pathways (i.e., RCP4.5, and RCP8.5). The climate information was analysed against the 100 m resolution gridded dataset of European Forest Types produced within the Horizon Europe project OptFor-EU, based on state-of-the art research, which guarantees the compatibility of the results with similar studies at the European level. While all the RFTs are already subjected to increasing temperatures extremes and precipitation intensities that will exacerbate in the next decades, we emphasise regional differences clustered in relation with the impacts due to the socio-economic risks of climate change. Considering the national coverage and the level of details provided by this study, the results will support the development of the adaptation and mitigation strategies and plans of Romania, as well as the local forest management practices within the climate change context.

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A climate lesson from oaks trees: an inter and intraspecific dendroclimatic approach in Eastern Europe

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Abstract

In this study we present three distinct oak chronologies from the Moldavian Central Plateau (eastern Europe) to assess how the oak species respond to climate, using different ring widths parameters (i.e., early wood tree-ring width, late-wood tree-ring width, and total tree-ring width). Although the oaks have a very similar anatomical structure and, studies made in Central Europe have shown insignificant differences between the oak species, no research has been carried out under limiting growing conditions. To explore the climate influence on tree ring width, we have selected three oak species, namely English oak (*Quercus robur*), sessile oak (*Quercus petraea*), and Italian oak (*Quercus pubescens*). Our results indicate that the variability of oaks tree ring width from the Moldavian Plateau is mainly influenced by the availability of water resources and vapor pressure deficit. At the specific level, the Italian oak and the sessile oak are more sensitive to water recourses than the English oak. Significant differences were assessed using the seasonal wood. While the English oak early wood has a weak response only to vapor pressure deficit, the sessile and Italian oak early wood is very sensitive to soil moisture and precipitations during the winter and spring.

Keywords

oaks; vapor pressure deficit; eastern Europe; seasonal wood; different climatic response.

Ecosystem monitoring – considerations for atmosphere, plant level and soil measurements

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Abstract

Continental-scale research infrastructures and regional flux networks, as well as numerous smaller greenhouse gas (GHG) flux networks, and individual sites, are often focused on measuring and modeling CO_2 and other GHG exchange between ecosystem and atmosphere.

Atmospheric monitoring stations employ tall towers and very high precision analyzers to monitor the concentrations of gasses within the bulk atmosphere. Such settings often provide dedicated lab space with available power and maintenance infrastructure.

Eddy covariance systems measure the exchange or flux of gasses between an ecosystem and the bulk atmosphere. They integrate predominantly carbon and water cycle data at ecosystem scales, with footprints often hundreds or thousands of meters in length depending on the measurement height. For a suitable measurement system, power requirements, harsh conditions during operation, local conditions and long-term operation capabilities need to be considered. Customized solutions are suitable to integrate biological and meteorological data. Multiple sensors both above and below ground combine to give a good overview of the total drivers of gas flux within the system.

In addition to evaluation of GHG fluxes between ecosystem and atmosphere, analysis of evapotranspiration (ET) is experiencing growing interest. If, however, ET measurements are the main objective a complete Eddy covariance system may not be an ideal solution due to the high costs and complexity of running these traditional flux stations. For the same reason these GHG stations are less readily used outside academia to provide immediate societal benefits: These may include agricultural water management, watershed management, water regulation and water use verification. A new cost-optimized solution for direct, automated, real-time evapotranspiration measurements attempts to resolve this problem. This provides a technology transfer of the evapotranspiration measurements from academia to broader research, regulatory, agricultural and commercial applications.

At the canopy level, calculating Leaf Area Index (LAI) allows accurate quantification of the area of leaf present per unit area of ground. Measurements can be made without the need to destructively sample the canopy and canopies modelled based on several assumptions, which can be addressed using suitable and well evaluated measurement devices.

Each leaf has a story to tell – integrated measurement of gas exchange and chlorophyll a fluorescence from the same area of individual leaves using a photosynthesis system can provide a complete picture of gas and electron flux. When used together, these techniques can provide a detailed way to assess the process of CO_2 diffusion from atmosphere to the intercellular leaf air space. Further measurement of fluorescence or CO_2 isotopologues even allows for analysis of CO_2 conductance from the intercellular airspace to the chloroplast for highly accurate determination of productivity.

In addition fast screening of leaves may be desirable to understand plant stress, limits to productivity or water availability. In these cases combined measurements of stomatal conductance and chlorophyll a fluorescence can be a powerful tool; a new technical solution for this task has recently been invented. When combined with additional data including incident angle of the sun to the leaf, location on earth, and exact time of day, the story becomes filled with details that can help you understand the physiology of a leaf.

Soils produce or consume a substantial amount of gases from the atmosphere through biological processes, including plant, insect and microbial respiration as well as organic matter decay. Gases—such as CO_2, CH_4, N_2O, and their isotopologues are continuously exchanged between the atmosphere and soil. Both survey and long-term, automated chamber based measurements help researchers quantify and characterize greenhouse gas emissions, understand the mechanisms that regulate gas flux, and monitor carbon sequestration efforts or leaks, amongst other applications.

Multiplexed systems, typically used for long-term automated soil measurements can also be deployed for profiling gas concentrations within an ecosystem layer, e.g. CO2 storage analysis in tall canopy, via profile measurements. Data can be derived from such system deployed in parallel to eddy covariance system allowing a comparison with EddyPro's one-point storage flux estimation.

Each of the gas fluxes at each of these scales and locations sum together having large effects on the atmosphere as a whole. By measuring and understanding these components we can begin to quantify and predict how individual actions may either allow us to achieve specific goals, such as improving plant productivity, or quantify our effects on the atmosphere as a whole.

Change in Norway spruce growth response to climate in Eastern Carpathians

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Abstract

Climate change is affecting forest ecosystems all around the globe, in particular through warming as well as increases in drought frequency and intensity. The change in climatic conditions may lead to different responses of forest species to environmental factors. Norway spruce (*Picea abies* (L.) H. Karst.) is one of the most important coniferous species at the European level. The largest Norway spruce continuous forests from Eastern Europe are located in the Eastern Carpathians (Romania). To analyze the climate-growth relationship of Norway spruce it was used a large dendrochronological network consisting of 157 research plots with over 3000 trees distributed along an elevational gradient from various age categories. Climatic data (daily temperature and precipitations) were downloaded from E-OBS grided database for each plot. Pearson correlation between periodic climatic data and basal area increment chronologies was computed for two periods. Results showed a change in correlation patterns for temperatures. At high elevations, the positive correlation between Norway spruce basal area increment and summer temperatures from the current year become insignificant in the recent decades. Meanwhile, in the last decades for all elevations, a negative correlation between previous summer temperatures and Norway spruce basal area increment was found. Regarding correlations between Norway spruce growth and precipitations, an increase in correlation values was reported for previous summer precipitation and a significant correlation pattern for the current summer. Overall, our results highlight the influence of climate change on Norway spruce sensitivity to climate.

Keywords

basal area increment (BAI); dendroclimatic model; daily temperature; daily precipitation; elevational gradient.

European beech in the Copșa Mică region: effects of industrial activity and local air pollution

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Abstract

Industrial pollution is one of the factors contributing to the degradation and even drying out of some forest ecosystems and to the amplification of climate change. Knowledge of the mechanisms and effects of pollution on forest ecosystems is therefore an important component of their management plans. Air pollution can alter the normal growth behavior of trees, both in terms of growth dynamics and response to environmental changes. The use of plants and trees as bioindicators of air pollution has for many years been a simple and effective way of highlighting the effects of pollution on forest ecosystems. The aim of this study is to analyse and quantify the effects of local industrial pollution on european beech (Fagus sylvatica L.) in the region of Copșa Mică, Romania. In this region, industrial activity such as non-ferrous metal processing and carbon black manufacturing started in 1936 and developed continuously until 1990. After 1990, the industrial activity was significantly reduced and stopped in 1993. Three areas with different degrees of damage were investigated: intensively polluted area, moderately polluted area and unpolluted area. By analysing the beech trees increment series, growth losses were highlighted during the period with intensive industrial activity, especially in the intensively polluted area. Resilience indices showed the period when intensively affected trees were able to recover growth lost during the period of very high industrial activity. Regarding the dendroclimatic response of trees, it is shown that monthly rainfall in the April-August period positively influenced tree growth, while monthly mean temperatures in the April-September period are negatively correlated with tree growth. The dendroclimatic models differed according to pollution intensity. Correlations with climate variables over different periods revealed a change in the response of trees affected by local pollution to the climate, compared to unaffected trees at times when air pollution was very high. Chemical analysis of tree rings over a period of 60 years showed that trees are able to accumulate heavy metals. Five heavy metals (Cu, Zn, Mn, Fe and Ni) were identified in the composition of the tree rings, the concentrations of which showed statistically significant differences at a 95% confidence interval in relation to the level of pollution.

Keywords

air pollution; european beech; forest ecosystems; tree resilience; tree ring.

Comparison of the Kjeldahl method and a combustion method for total nitrogen determination in needles in the Carpathian Mountains

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Abstract

Needels samples for pine and spruce were collected in the II Level Intensive Monitoring Grid of the ICP Forests Programme, are located in the southern part of the Carpathian Mountains at altitudes varying from 600 m to 1300 m. The paper focuses on the comparison of the Kjeldahl method and a combustion method for total nitrogen determination. The precision and accuracy of both methods were considered to be adequate for this type of material and compared favorably. The automatic Dumas method gave slightly higher results than the Kjeldahl method and a statistical evaluation of the experimental data showed that the Kjeldahl method was generally more precise.

Keywords

needels; nitrogen; Kjeldahl method; combustion method; Carpathian Mountains.

Biogeographical and altitudinal patterns of tree growth sensitivity to climate in Romanian Scots pine forests

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Abstract

Scots pine (Pinus sylvestris L.) is among the most sensitive coniferous species to ongoing climate change in Europe. However, previous studies on its growth response to increasing temperatures have yielded contrasting results (from stimulation to suppression), suggesting highly site-specific responses. Here, we present the first study that applies the non-linear, process-based Vaganov-Shashkin Lite (VSL) model and linear monthly response functions in Romanian Scots pine forests. Data were collected at 34 sites differing in climate regimes and ranging elevation between 100 and 1600 m a.s.l. We observed a high site-to-site variability in the climate–growth relationships with significant positive influence of current march temperature and marginally with current April precipitation. This relation augmented as elevation ($r = 0.35$, $P < 0.01$) and latitude ($r = 0.31$, $P < 0.01$), respectively. Current wet spring conditions was negatively related to elevation ($r = -0.34$, $P < 0.01$), increasing eastward ($r = -0.55$, $P < 0.01$), whereas higher correlation with summer precipitation decrease northward ($r = -0.35$, $P < 0.01$). VSL model results revealed that drier Scots pine sites at lower elevations are mostly moisture limited, while moist high-elevation sites are generally more temperature limited. The correlations between the observed and fitted series of ring-width indices were positively related to the duration of soil moisture limitations and temperature and negatively with elevation, precipitation and aridity. The minimum temperature for growth was negatively related to optimum soil moisture for growth and elevation, whereas days with soil moisture limitation was influenced by warmer and drier conditions during the growing season associated with higher climate sensitivity at lower elevations. For all other sites, the future radial growth of Scots pine in Romania largely depends on the balance between late winter and spring temperature and spring precipitation.

Keywords

dendroecology; VS-lite; tree-rings; Pinus sylvestris; biogeographical patterns; climate sensitivity.

The effect of smoke and the heat of complex wildfire in Sertã in the synoptic system

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Abstract

Portugal has had a long fire occurrence in the landscape during the dry season in the last 25 years, and in the countryside many plants are adapted to survive fire, and some depend on fire regimes to purge and promote their own reproduction. The Mediterranean ecosystems have been adapted to a socioecological system conducted by men and molded by fire and socio-economic interests to make the use of forest and wilderness areas more profitable. Due to forestry policies, many of these areas have been depopulated or abandoned in recent decades, with forestry fuels accumulating and becoming increasingly dangerous and difficult to fight during rural fires. Meteorological changes are making ecosystems more vulnerable to wildfires and have lengthened the fire season, altering fire size, intensity, and frequency. Most of extreme fire events in Portugal happened during heat wave episodes and in meteorological years aggravated by periods of drought, leading to dangerous fires in the forests throughout the country. In turn, there is a growing concern of the civil authorities about delivering alerts to protect the health of population from exposure to massive smoke from wildfires. Thus, it is important to understand the dynamics of interaction, between the atmosphere and the emitted smoke, particularly during extreme wildfires. The complex of extreme fires of Sertã, which occurred on October 15th, 2017, in a forestry valley region between mountain ranges situated in the north center of Portugal, was studied in this research. The forcing produced by the hot air plumes, the turbulence generated by the fire into the synoptic system, as well as the dispersion of smoke, were evaluated. This event occurred during a synoptic situation with the thermodynamic and dynamic structure of the atmosphere comprised by a turbulent boundary layer, encompassed by cold, hot, and occluded frontogenic systems, intensified by the Ophelia hurricane. This atmosphere was forced by sensible heat fluxes generated by the fires, which raised thermals to high levels in the atmosphere. This analysis was generated with the resource of a numerical weather prediction model. This model is designed to simulate atmospheric circulations spanning from planetary-scale waves down to large eddies of the planetary boundary layer and it is coupled to a spread fire model. This model was fed by meteorological reanalysis from

ECMWF and by surface data from ICNF and CEIF/ADAI. The results were crossed with observed data from CEIF/ADAI and Portuguese air quality station data. This research has provided useful information about fire interaction and the related change in atmospheric processes.

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The Relationship Between Stem Dehydration, Tree Growth, and Climate Indices

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Abstract
The frequency of extreme events, such as heatwaves, has increased in Romania over the past few decades. Recent studies have shown that in the south, south-eastern, and central parts of Romania, the number of days with an excess heat factor (EHF) exceeded 6.5 days per year during the period of 1971-2000. Additionally, these studies indicate that under different climate scenarios (RCP4.5 and RCP8.5), the number of days with EHF is projected to significantly increase (Antonescu et al., 2023). Thus, the monitoring of the radial variation of tree stems throughout the year is essential for comprehending how trees respond to changes in environmental conditions, including temperature, rainfall, and climate indices like heatwaves or dry days. This monitoring process can be facilitated using automatic dendrometers, which are measuring the stem variation of trees. These measurements capture diurnal patterns of water storage depletion and replenishment, as well as seasonal tree growth. The automatic continuous point dendrometers are placed in four representative plots for Romanian forests, which collectively cover an altitudinal transect. Two locations where the automatic dendrometers are situated include Ștefănești (southern Romania), Mihăiești (southern Subcarpathian), These locations encompass two tree species: oak (*Quercus robur* L.), and sessile oak (Quercus petraea L.). Dendrometer data were collected continuously at hourly time resolution since 2017 on 60 trees using HOBO U12-008 4-Ch Ext Out/Ind devices and software version HOBOware 3.7.25 (Onset Computer Corporation, USA). The raw data underwent curation and conversion into millimetres of radial growth using the R interface. The treenetproc library in R was then employed to detect

errors, with manual adjustment of thresholds for identifying outliers and jumps for each species to ensure accuracy and consistency (Knüsel et al., 2021). Also, errors were investigated on a monthly basis. After data curation, dendrometer time series were selected based on existing gaps in time series, particularly during the growing season in order to assure data quality and comparability. For gaps shorter than 24 hours, a cubic spline interpolation was applied. Climate indices were derived from the E-OBS database, which provides data at a spatial resolution of 0.1^{o}x0.1^{o} and daily frequencies for the corresponding time periods. The indices like: Warm days - percentage of days when then daily maximum temperature is greater than the 90^{th} percentile of maximum temperature or Consecutive Dry Days index - maximum number of consecutive dry days ($R \leq 1mm$) were calculated. The study underlines the relationship between stem dehydration, tree growth, and climate indices, considering both annual and monthly variations. The impact of climate indices on annual growth is examined, highlighting the effects of climate factors on the physiological processes of trees.

Keywords
stem dehydration, tree growth, automatic dendrometers, climate indices

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Levels of Na/Cl ratio in bulk precipitation and throughfall in Romania

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Abstract

Values of Na/Cl ratio in precipitation samples are an important clue for validation of results of chemical analysis obtained within the ICP Forests Programme for monitoring atmospheric deposition, which assess and monitor the impact of air pollution on forest ecosystems. It is recommended that the values be included in the range 0,5-1,5, considering that most of the chloride originates from sea-spray and that the contribution of marine ions in atmospheric deposition is in the same molar ratio (0,86) as in sea-water. The study was performed for 4 Level II plots (Rarău-molid, Fundata-fag, Mihăești-gorun și Ștefănești-stejar), according to the ICP Forests methodology, for the period 1998-2021. From 1998 to 2008, sodium was analyzed using atomic absorption spectrometry and chloride, by UV-VIS spectrometry. Beginning with 2009, sodium and chloride were analyzed by ion chromatography, using a simultaneous system for cations and anions. For values close to the detection limits of sodium and chloride, the values of the ratio were always not in the recommended range. Quality assurance and quality control of results (QA/QC) within ICP Forests at European level concern the Expert Panel on Deposition, who ensures the development and harmonization of the monitoring methods and contributes to the data evaluations. The importance of this parameter was studied at European level, but the actual study presents for the first-time results from Romanian monitoring system.

Keywords

ICP Forests; forest monitoring; atmospheric deposition; spectrometry

Forests response to the impact of climate change what about the role of active sylviculture?

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Abstract

Forests are playing an important role in the carbon uptake from the atmosphere. Currently, European forests annually absorb up to 10% of total GHG emissions. It means that forests have an incredible ability to store carbon in biomass and soil. There is a new opportunity for forestry: to implement and actively manipulate carbon storage, i.e. to offer new ecosystem services. Research was conducted to evaluate the impact of classical forestry management practice i.e., thinning, on the biological carbon pumps in a forest stand, because thinning is strongly related to the solar radiation condition improvement. The forest stand canopy is strongly vertically and functionally differentiated – sunny and shaded foliage. The participation of these foliage ecotypes in whole canopy carbon uptake is very different. Stand-shaded leaves output for carbon pumping is negligible in the dense forest. Thus, thinning has a big potential for activation of whole canopy carbon uptake and storage mainly because of improved solar radiation penetration in the crown body and thus achieves stronger participation of lower crown parts in the whole forest stand canopy photosynthetic activity – i.e., activation of the additional carbon pump. This effect is temporary but repeated thinning can keep it for a longer time. It means that thinning could be considered an effective tool for the „IRRITATION" of stand canopy production activity. The research conducted on stand-level chronosequence of carbon fluxes and radial increment dynamics supports this conclusion. It means that thinning, as the classical forest management practice, has the potential to enhance the output of stand canopy carbon storage capacity and support the role of cultivated forests in GCC mitigation.

Keywords

Forests; carbon; landscape; sylvicultural action; thinning,

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KEYNOTE SPEAKER

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Biodiversity conservation in temperate forests: experiences from South America

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Abstract

Temperate forests are those located between tropical and boreal regions. They cover around 25% of the world's forest area and are distributed from 25 to 50º latitude in both hemispheres, spanning in a wide variety of climates and precipitation regimes, from dry to rainforests. They historically suffer several anthropic impacts (e.g., logging, farming, mining, hunting, urbanization, climate change, biological replacement or invasion) as well as natural disturbances (e.g., catastrophic events as volcanic eruptions or tsunamis), with strong effects on biodiversity and habitat loss (e.g., deforestation, pollution, fragmentation, changes of land use by replacement with exotic tree plantation). Biodiversity in temperate forests greatly depends of some old-growth characteristics (such as large old and dead trees), which have been drastically reduced in temperate forests around the world. Therefore, this biodiversity faces local extirpation or extinction, even in countries that remain largely forested. The main challenges for biodiversity conservation in temperate forests are to protect endangered and/or emblematic forest types and/or species, conserve particular habitats within some forest types, and maintain connectivity between temperate forest patches. Usual and traditional practices implemented worldwide for conservation are to enlarge the land and quantity of protected areas, and set aside forests with management restrictions because it is often considered these will be best preserved by non-intervention. This target is generally expensive and inefficient because forests are usually intermingled with other ecosystem types in the landscape matrix. On the other hand, the management exclusion cannot be enough for preservation in the long term in protected forests where biodiversity values are legacies from past disturbances, as fires, grazing or selective logging, and silviculture could play a fundamental role when forests need active management to maintain valuable characteristics. Also, conservation strategies should include careful planning and regulation of land use in the surrounding matrix of a protected area, environmental education, and network development among conservationists, scientists, managers and private landowners. In South America, temperate forests occupy a long but latitudinally narrow strip, extending from 35 to 55ºS in the southernmost extreme of the continent. The more usual conservation strategy is to split forest remnants with high conservation value from management, to avoid impacts and modifications. However, those areas requiring protection are usually more accessible, highly-priced or more suitable for productive uses, and are usually in private hands. Therefore, other conservation strategies are proposed, for example, a combination of extensive protected areas that enclose wild landscapes (land sparing) with small and valuable forest remnants

in managed areas (land sharing). Experiences in monospecific Nothofagus forests, obtained from variable retention management, are presented as evidence of this biodiversity conservation strategy implemented in South America.

Keywords
native forests; variable retention; conservation strategies; silviculture.

Classifications based on functionality improve estimates of monitoring in forests of Tierra del Fuego, Argentina

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Abstract
Forest classifications are mainly based on tree species, and are not effective to characterize ecological processes related to management and conservation. One alternative is using functional forest types (phenoclusters, [1]), which were also used to determine forest resilience [2]. Besides, monitoring design needs novel approaches that consider the long-term effects of climate change [3]. The objective was to classify and map the forests of Tierra del Fuego (Argentina) according to their phenology characteristics (EVI time series from Sentinel2 and Landsat8) and regional climate (LST Band 10 TIRS Landsat8 and BIO12 from Wordclim). 27 categories were determined, which were grouped using cluster analysis into 6 types. These groups were characterized through ecosystem services (ES, provisioning, regulating, supporting, cultural) and biodiversity (proxy: understory species), and tested with ground-truth data (forest structure, soils) according to different forest types using uni- and multivariate analyses. Results showed significant differences for all the variables, which were not detected through the traditional forest-type

classification. Multivariate analyzes showed gradients among functional forest groups in relation to the landscape. Differences were also found also for different ES, including phenoclusters of the different forest types. The results showed the advantage of including these complementary classifications to differentiate natural forest types according to their functionality. Besides, functional groups detected for each forest type highlight their potential uses or their intrinsic characteristics, allowing the development of new management and conservation strategies, e.g. specific stocking rate, timber yield, or conservation values. Finally, these phenocluters also allowed differentiating forests with differential responses to management (e.g. natural regeneration) or climate change resilience.

Keywords
forest functionality; management; conservation; resilience; Patagonia.

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Conservation *in situ* and *ex situ* of plant diversity in the forests of the Republic of Moldova

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Abstract
For the *in situ* conservation of plant diversity in the forests of the Republic of Moldova, the following measures have been implemented: 5 scientific reserves (covering an area of 19,378 hectares); 13 nature monuments, representative sectors with forest vegetation (covering an area of 125.2 hectares); 51 forest natural reserves (covering an area of 5001 hectares); 9 natural reserves for medicinal plants (covering an area of 2796 hectares); 41 landscape reserves (covering an area of 34200 hectares) [1]. Based on the conducted research, the floristic, phytocenotic, and arboreal composition has been identified, and the boundaries of the protected areas have been determined. Maps have been developed, and a database has been compiled regarding the plant diversity within the system of state-protected natural areas. The protected areas in Moldova harbor 172 species of rare plants, out of which 52 plant species are classified as critically endangered. The *in situ* conservation of plant diversity in beech (*Fagus sylvatica*) forests is carried out in 2 scientific reserves, 2 nature monuments, 4 natural reserves, and 2 landscape reserves. Beech forests host 41 species of rare plants, including 23 species listed in the Red Book of the Republic of Moldova, while the Lady's Slipper Orchid (*Cypripedium calceolus*) is included in the Red List of rare plants in Europe. For the *in situ* conservation of plant diversity in sessile oak (*Quercus petraea*) and pedunculate oak (*Quercus robur*) forests with hornbeam, 34 protected areas have been established, including 2 scientific reserves ("Codru" and "Plaiul Fagului"). The gene pool of oak forests within these protected areas includes over 750 species of vascular plants. Sessile oak and pedunculate oak forests house 81 species of rare plants, out of which 50 species are listed in the Red Book of the Republic of Moldova. The *in situ* conservation of plant diversity in pubescent oak (*Quercus pubescens*) forests is carried out in 15

protected areas. These areas encompass a gene pool consisting of over 550 species of vascular plants. The protected areas in pubescent oak forests shelter 53 species of rare plants, with 26 species included in the Red Book of the Republic of Moldova. Based on rarity, 14 plant species are categorized as critically endangered, 12 species as endangered and vulnerable, and 27 species as taxa with low risk. The *in situ* conservation of plant diversity in landscape reserves with forests on rocky substrates is carried out in the "Iagorlac" Scientific Reserve and 26 other protected areas. The floristic composition includes a gene pool of over 700 species of vascular plants, with 104 species classified as rare plants. The Red Book of the Republic of Moldova includes 47 species of rare plants, while *Pulsatilla grandis* and *Schivereckia podolica* have been listed in the Red List of rare plants in Europe. The *in situ* conservation of plant diversity in riparian forests is carried out within the "Pădurea Domnească" Scientific Reserve and 12 other protected areas, covering a total area of 6313.1 hectares, which represents 31.4% of the riparian forest area. Over 700 species of vascular plants have been recorded in these protected areas. Currently, these protected areas harbor over 26 species of rare plants, out of which 13 are included in the Red Book of the Republic of Moldova. Based on rarity, 3 plant species are categorized as critically endangered, 10 species as endangered and vulnerable, and 13 species as taxa with low risk. Based on research, a four-volume monograph titled "Protected Natural Areas of Moldova" has been developed, including Volume 2: "Secular Trees" by Gheorghe Postolache, 2015, with 180 pages, and Volume 3: "Forest Reserves" by Gheorghe Postolache and Ștefan Lazu, 2018, with 212 pages, which reflect the achievements in the *in situ* conservation of plant diversity in Moldovan forests. For the *ex situ* conservation of plant diversity, the "Alexandru Ciubotaru" National Botanical Garden (Institute) has created the "Vegetation of Moldova" Exhibition (14 ha) where 12 micro-exhibitions representing forest ecosystems have been established, including beech forests, oak forests with hornbeam, oak forests with lime and ash, oak forests with maple, pubescent oak forests, and riparian willow and poplar forests. These micro-exhibitions contribute to the *ex situ* conservation of a gene pool consisting of over 500 species of plants, including 40 species of rare plants.

Keywords
in situ conservation; ex situ conservation; plant diversity; protected areas.

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Impact of active coppice management on microclimate and understory vegetation in a Mediterranean oak forest

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Abstract

Plant diversity of the forest understory contributes to forest functionality and provisioning of ecosystem services. In recent years, however, understory thermophilization processes caused by global warming have been detected especially in temperate regions with warm macroclimate, such as the Mediterranean one. Coppice-with-standards is still one of the most common types of management of broadleaved and evergreen forests in this region, aimed at the production of renewable energy, especially firewood. Trees are cut at regular time intervals, thus leading to cycles of vegetative regeneration. However, the strong modification of forest structure caused by coppicing could mine the capacity of forest canopy to buffer temperature extremes and to offer microclimatic refuges for the herb communities. Hence, it is crucial to assess the sustainability of this traditional management form under the current climatic stressors. We contributed to this topic by analyzing shifts in temperature buffering capacity, understory diversity (taxonomic, phylogenetic, functional), and productivity in an ancient forest of central Italy with Quercus cerris and Q. petraea (Bosco ai Frati, Tuscany). Here coppice-with-standards and high forest are next to each other and under homogeneous site conditions since long time. To this purpose, in 2021 we installed air and soil temperature dataloggers in three high forest sites and three coppice-with-standards sites. Following a nested sampling design, forest structural variables light availability (photosynthetic active radiation) and soil pH were determined before surveying understory vegetation in four 5 x 5 m randomly selected quadrats in each of the six sites (24 quadrats). Understory aboveground productivity (dry weight of herbaceous and woody biomass) was determined in 48 0.5 x 0.5 m plots (two per quadrat). Moreover, five functional traits associated with the acquisition and conservation of resources (vegetative traits) and reproductive efficiency were collected from the TRY database: Specific Leaf Area, Leaf Dry Matter Content, plant vegetative height, plant reproductive height, and seed mass. Regarding microclimate, we confirmed the strong effect of forests in limiting maximum temperatures. The mean offset values between forest and reference open areas in daily maximum temperatures were significantly larger in the high forest than in the coppice stands during all seasons. Our results supported that coppice management promotes understory species richness, although this is due to the presence of mostly generalist and light-demanding species with strong colonization capacity. Interestingly, coppicing led to a clustering in phylogenetic structure (measured with Mean Nearest Taxon Distance) and differed significantly from high forest in functional diversity for Leaf Dry Matter Content, highlighting the presence of ongoing acclimation processes in the understory. Coppicing also influenced the diversity-productivity relationship. In the light of these results, we emphasize the need to

take into account different facets of plant diversity, to reach a more holistic understanding of the effects of coppicing on deciduous oak woodlands of the Mediterranean region, on especially plant diversity and temperature buffering capacity of the forest canopy.

Keywords
forest management; biodiversity; understory vegetation; microclimate;

Understory variation and the influence of biotic and abiotic environmental factors in Nothofagus antarctica forests of Tierra del Fuego (Argentina)

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Abstract

The understory vegetation, as an integral component of native forests, plays a fundamental role in nutrient and energy recycling, as habitat for biodiversity, and for the stability and resilience of the ecosystem against impacts. It is also a shelter for arboreal regeneration, and a source of resources for productive activities, e.g., forage for cattle in silvopastoral systems. In a specific forest type, the understory characteristics vary in their natural distribution area, being influenced by changes in the structure of the canopy, soil, climate and other environmental factors of site and landscape, under natural or human modified conditions. Vascular plant assemblage in the understory of Nothofagus antarctica forests are among the most diverse of Tierra del Fuego (Argentina). However, there is a lack of information on how it varies, and how biotic and abiotic environmental factors influence its structure. Therefore, the aim of this work was to analyze the variation in understory structure and the effect of some biotic and abiotic environmental factors on richness, cover and biomass, in order to detect the most influential variables that could be modulated through management. We analyzed 137 stands of N. antarctica forests, evenly distributed in their natural range on Tierra del Fuego, including forests with different ages under natural dynamics and with different degrees of disturbance (harvesting, livestock use, fire). For each stand, we evaluated (i) specific richness (n° of species) by floristic survey; (ii) ground cover (%) by point intercept method; and (iii) dry matter biomass (kg DM/ha) by manual collection in 0.25 m2 plots and weighed after oven-drying to constant weight. Different environmental characteristics were also surveyed, including biotic (forest structure, net productivity) and abiotic (edaphic, climatic) variables. For forest structure, dominant height (m), basal area (m2/ha), density (individuals/ha), stand density index (%), mean square diameter (cm), total volume with bark (m3/ha), crown cover (%), and relative leaf area index were obtained. Among the edaphic characteristics, we surveyed apparent

soil density, soil moisture, content of carbon, nitrogen and phosphorus content (kg/m2/30 cm depth), organic matter (%), and pH. Climatic variables included the total/incident radiation rate (%), plus 11 temperature variables measured in °C (annual average, daily amplitude, isothermality, seasonality, maximum of the warmest month, minimum of the coldest month, annual amplitude, mean of the wettest quartile, mean of the driest quartile, mean of the warmest month, mean of the coldest month) and 8 precipitation variables measured in mm/year (annual, of the rainiest month, of the driest month, seasonality, of the rainiest quartile, of the driest quartile, of the warmest quartile, of the coldest quartile). Other variables were the topographic elevation, the distance to rivers (m), the global aridity index, the global potential evapotranspiration, and the net primary productivity. Data were analyzed by univariate and multivariate analyses, including correlations, generalized linear models, non-metric multidimensional scaling and multi-response permutational proceeding. Forest stands under natural dynamic presented variations in the understory structure (from 6 to 43 species; 38-300% cover, 60-6400 kg DM/ha biomass) depending on stand age (young stands with the lowest values). Disturbances heterogenized the understory, both by species incorporation and loss, leading also to changes in cover and biomass. Regarding the most influential variables, basal area, mean square diameter, apparent soil density, soil nitrogen content and elevation were important in modelling richness; while phosphorus content and elevation influenced understory cover. Basal area, mean square diameter and soil nitrogen content were used to modelling understory biomass. Some of these variables can be modified by human practices (e.g., basal area and mean square diameter by harvesting), thus the understory structure of N. antarctica forests can be managed for livestock use and/or conservation. However, the permeability to foreign species and the susceptibility to species loss when affected by strong disturbances indicate the convenience of excluding some patches from management, for the preservation of more diverse natural structures within the matrix of managed forests.

Keywords
native forests; silvopastoral systems; forest management; specific richness; ground cover; dry matter biomass.

Influence of the stress factor under the conditions of climate changes on weakening of trees and appearance of pathogenic and epyxilous fungi in natural beech stands

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Abstract
The paper presents the examination of the health condition of beech stands from the aspect of mechanical and abiotic damage on trees. The research was conducted in the Forest Management Office Kucevo, in a hillside beech forest *Fagetum moesiacae submontanum* of generative origin. The research included 505 trees on 28 sample plots. A strong correlation was found between the appearance of fungi and the presence of injuries – 51.88%, as well as between the presence of fungi and abiotic damage – 47.96%. It was determined that the health condition of high beech forest heavily depends on careful and proper manipulation during logging, while every injury sustained by standing beech trees during felling opens an access point to dangerous microorganisms.

Keywords
mechanical and abiotic damage; beech stands; fungi;

Vegetation diversity in Romanian ICP-Forests Level II plots

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Abstract

International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) was established in 1985. ICP Forests' monitoring activities, especially in the intensive Level II plots, can reveal the effects of climate change on forest ecosystems and can contribute to a sustainable forest management in relation to forest health and forest biodiversity [1, 2]. In Romania, 12 Level II sites (each with 5 plots) were installed in 1992 in representative forests ecosystems at national level. Vegetation is a major component of forest ecosystems. The composition, diversity and structure of vegetation are important factors for assessing the biological diversity of forest ecosystems [3]. The methods used for the analysis of flora diversity and vegetation assessment in Romanian ICP Forests Level II plots are consistent with the ICP Forests methodology [3]. Within all the 60 plots inventoried, 219 vascular plant species and bryophytes were found. The highest values of Alfa-diversity - species richness (S) and Shannon diversity index (H') - were recorded in the mesic oak-hornbeam forests at Ploieşti (*Aro orientalis-Quercetum pedunculiflorae*; S=33; H'=2.29) and in the mountain beech forests (*Pulmonario rubrae-Fagetum*; S=37; H'=2.17) at Predeal. Using numerical syntaxonomic methods (Hierarchical clustering and Non-metric Multidimensional Scaling), the analyzed forest communities were grouped in seven ecologically distinct clusters. This result highlights the spatial distribution of forest phytocoenoses at the ecosystem level, according to their floristic structure and the existing ecological gradients.

Keywords

forest ecosystems; floristic structure; species richness; Shannon diversity index; umerical syntaxonomic methods.

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The role of traditional ecological knowledge practices in conservation of Divjakë-Karavasta National Park Forest ecosystem

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Abstract

Through traditional ecological practices local communities, ensure the sustainable utilization and management of different ecosystems services. In order to have an effective biodiversity conservation, it is important to take in consideration the local knowledge, its intergenerational transmission, limitation in the use of natural resources, sustainable use of the biodiversity inside and outside of a protected area. This study examines the role, evolution of traditional management practices and the local perceptions of impacts on forest ecosystem diversity conservation. Within this case study, our goal is to understand the evolution of the traditional ecological knowledge in the Divjakë-Karavasta National Park, collecting data about local management practices and the impact of these activities on the current status of the forest ecosystem. Our results suggest that the perception of local communities for the landscape change and the traditional knowledge are vital for natural resources sustainability. We found through our fieldwork, lack of forest infrastructure such as maintenance of open paths and the road network, since the existing one has been closed. Problems that make it difficult to improve the intensity of the forestry economy and the realization of recreational and educational facilities. This study provide evidence that rural community is a valuable source of information in monitoring environmental changes, which might be consider in future conservation policies, with the aim in preventing biodiversity loss."

Keywords

traditional knowledge; biodiversity; conservation; rural community;

Forest species growth and crown architecture in a newly established silvopastoral system

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Abstract

Silvopastoral systems represent an important agroforestry system in Romania. The lack of tree care and management works within the silvopastoral systems and some measures to help natural regeneration led to the diminishing of their protective role, respectively to a reduction in the number of trees on the pasture and, thus, the transformation of pastures with trees into simple pastures.

Against the backdrop of climate change, the importance of forest species on pastures is increasing, so in a 421.7 ha pasture, belonging to Bod Municipality, an experimental device of 12 ha was installed in 2019, through which forest species were introduced to the pasture. It consisted in the installation of 12 groups of trees, consisting of different forest species: oak, sessile oak, maple, ash, cherry, lime, corresponding to local seasonal conditions.

The installation of trees on pastures aims to protect grazing animals (through shading and shelter), the development of a vegetal layer richer in forage species and with higher nutritional value, but also meets some ecological requirements in accordance with the measures claimed to reduce the negative effects of climate change. Ensuring regional biodiversity and increasing the amount of carbon stored in plant biomass are two important ecological objectives achieved and analyzed through the installation of trees.

At the end of each growing season, the height of the forest species was measured. In addition, in 2022 the diameter at root collar, the crown projection, living crown, the growth of the terminal shoot, the growth of a lateral shoot and branch characteristics: number, length and diameter were measured. Also in 2022, the dry biomass of the leaves of all forest species was determined. The response of the seedlings used to the light in open field conditions was studied by analyzing the architecture of the crown of the forest species, on the basis of which works can be done to direct the crown and the most suitable forest species can be chosen, so that they shade in a while shorter a larger area.

Keywords

silvopastoral systems; forest species; crown architecture; biomass; biodiversity.

Virulence of pathogens present in forest crops in current climate conditions

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Abstract

Introduction. The implementation of sustainable forestry, a desideratum of the current forestry policy, requires the production of a healthy and vigorous planting material, in the necessary assortment, quantity and quality. In the intensive crops (solar plants, nurseries) where the seedlings are produced, with the ensuring of optimal conditions for development, premises are also created for the development of infections with different pathogens, or infestations with various pests. It is thus necessary to apply both preventive (essential in the case of pathogens) and curative treatments.

Since certain products used to control pathogens no longer meet the new trends for environmental protection, it is necessary to carry out studies on the adaptability of pathogens to new climatic trends as well as to the adaptation of new fungicides to the needs of forestry. These involve combining studies in the laboratory with those regarding the observation of the behavior of pathogens in the field.

Material and method. Thus, the morphology of the main pathogens was determined in the laboratory by going through the stages of isolation, incubation, lining out, examination and identification by means of specific microbiology and microscopy techniques. The main pathogens identified were on soil, on seeds, and on nursery crops. Thus, experimental blocks were placed to follow the evolution and control of diseases, in which treatments with the latest generation antifungal products approved by the EU and FSC were applied. The fungicides used were administered in the form of solutions, depending on the conditioning mode of its product, carrying out 3-5 treatments, depending on the evolution of the pathogen, which is closely related to local climatic factors. Also, in order to correlate the evolution of diseases with environmental factors, Data Logger devices were placed to record data on humidity and air temperature. Results. The main pathogens of forest crops were identified and a database was established, mainly with those that attack resi0ousn seedlings in greenhouses. This complex is represented by soil pathogens from the genus *Fusarium* spp., *Pythium* spp., *Rhizoctonia* spp., *Botrytis* spp., as well as the saprophytes *Aspergillius* spp. and *Mucor* spp., and it is invariably recommended to apply preventive treatments to the seedbed, respectively seed treatment, as well as the application of alternative treatments. Also, pathogens of the genus *Erysiphe* spp. and *Blumeriella* spp. have been reported in nursery crops. Conclusions. Forest crops are regularly affected by various pathogens, although their spectrum is generally known, it requires periodic updating of knowledge about their morphology to correlate it with the dynamics of environmental factors. In parallel with the new data obtained, the control technologies will also be updated, thus establishing the optimal periods of intervention in a timely manner, thus avoiding important damages, which can reach the disappearance of the culture.

Keywords

pathogens; fungicides; seedlings; environment.

The role of deadwood for biodiversity conservation in Douglas fir (Pseudotsuga menziesii (Mirb.) Franco) planted forests: a case study in Central Italy

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Abstract

In the reforestation programs developed in Italy after World War II, Douglas fir played a crucial role due to its productivity and timber quality. Forest management interventions in the Italian plantations are oriented to increase the provision of ecosystem services as well as timber production. In forest management aimed at improving diversity in planted forests, the identification of diversity indicators is a priority, as it is the deadwood a key indicator related to forest biodiversity. This study aims to define and implement a set of indicators to measure the diversity of Douglas fir planted forests considering stand and deadwood attributes related to biodiversity conservation. The set of indicators was implemented in a Douglas fir stand in Central Italy realized on degraded Sweet chestnut (*Castanea sativa* Mill.) stands and abandoned agricultural lands. The identified indicators include two stand indicators (tree species composition and horizontal structure) and five deadwood indicators (deadwood volume by size, deadwood diversity by species and decay class, and number of habitat trees). The results show that the Douglas fir stand is characterized by a high number of Douglas fir trees (88.6% of stem density, 94.0% of basal area) with some young broadleaved trees and ancient Sweet chestnut (Shannon index of 0.2±0.34 and Diameter differentiation index of 0.20±0.09). The deadwood indicators highlight a total volume of 62.0 m^3 ha^{-1}, mainly consisting of coarse woody debris (86.4%) and a diversified distribution by species (Shannon index of 0.29±0.33) and decay class (Shannon index of 1.30 ± 0.10). Based on these results, it emerges that planted forests are simplified systems in terms of tree species composition and stand structure; therefore, the amount of deadwood and its diversification plays a key role in biodiversity conservation. The set of indicators proposed in this study can be implemented in other planted forests to monitor changes in stand diversity over time.

Keywords

forest management; plantations; Shannon index; Diameter Differentiation index; Tuscany region - Italy.

Diversity of ground beetles in poplar short-rotation coppices and nearby habitats in northeastern Romania

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Abstract

Woody energy crops are expanding more and more in Romania. Poplar short-rotation coppices (PSRC) are mainly installed on former agricultural land, but this land change might affect both soil fertility and biodiversity. These aspects are still poorly understood. The objective of the research was to compare the diversity of ground beetle assemblages (GBA) found in PSRC with that of assemblages found in nearby traditional habitats, like wheat (W) or rapeseed (R) crops, pastures (PA) and periodically flooded riverside forests (PFRF).

The research was conducted in two places (Dornești and Satu Mare) of Suceava County, for two consecutive years (2013 and 2014). Five Barber traps were used each year in each habitat. They were installed 50 m apart from each other and from the edge of the habitat. Insect trapping was done from late April to mid or late October, checking the traps fortnightly. Data were processed to characterize the structure and diversity of the GBA in each habitat, separated by year and study site. The rarefaction curves of the number of species according to the number of specimens were also analyzed. To see to what extent the respective assemblies differ from each other, NMDS analysis was performed, based on the Bray-Curtis similarity index, followed by PERMANOVA. Then their clustering was analyzed using the agglomerative hierarchical clustering method.

Overall, In the two years, a total of 6064 carabid specimens were captured, representing 87 species, 33 genera, and 13 subfamilies, of which 3812 specimens (63 species) in Dornești and 2272 specimens (66 species) in Satu-Mare. In 2013 and 2014, 2440 individuals (65 species) and 3664 individuals (74 species), respectively, were captured. In the second year, 26 and 14 species were caught more in Dornești and Satu-Mare, respectively, than the previous year.

Cumulatively over the two years, fewer species were captured in PSRC (21 in Satu-Mare and 22 in Dornești) than in the other habitats. In both places and in both years, PSRCs had more species in common with W crops (10-11 in 2013, 7 in 2014), R crops (5), or PA (8-11 in 2013, 5-6 in 2014), than with the PFRFs (4 in 2013, 2-5 in 2014).

In PSRCs, the 4-7 dominant species totaled 78.9-95.8% of the catch, as in the other habitats. The dominant species in the PSRC at Dornești were *Harpalus rufipes*, *Poecilus cupreus*, *Pterostichus melanarius*, *Carabus cancellatus*, and *Calathus fuscipes*, the first three ones also being dominant in W and R crops. At Satu-Mare, the dominant species in PSRC were *H. rufipes*, *Harpalus affinis*, *P. melanarius*, *Broscus cephalothes*, *Poecilus lepidus*, *Calathius erratus*, and *C. fuscipes*, some of them also being dominant in the W crop and/or in the PA. Except for *C. cancellatus*, all the species mentioned are eurytopic. In addition, except for the species *C. cancellatus*, *P. cupreus*, and *P. melanarius*, they are xerophilous.

The richness of species in PSRCs was between 11 species (in Satu-Mare, 2014) and 19 species (in Dornești, 2013), - in general - similar to or somewhat lower than in the other habitats. The Chao 1 and iChao 1 species richness estimators, as well as the rarefaction curves, suggest the existence of a larger number of species, both in the investigated PSRCs and in the other habitats.

The Shannon diversity index (H) had, in the case of GBA from PSRCs, a value between 1.40 (Dornești, 2013) and 2.07 (Satu-Mare, 2014), while in the other habitats values between 1.36 (PA, Dornești, 2013) and 2.58 (degraded PFRF, Satu-Mare, 2013). The Buzas-Gibson's evenness index (E) had values between 0.21 (Dornești, 2013) and 0.72 (Satu-Mare, 2014), in PSRCs, and between 0.23 (W, Sat-Mare, 2013) and 0.74 (PA, Satu-Mare, 2013) in the other habitats. The Shannon equitability

index (J) had the minimum value (0.48) in the poplar crop at Dornești, in 2013, and the maximum value in the poplar crop at Satu-Mare, in 2014 (0.86) and in the degraded PFRF at Satu-Mare, in 2013 (0.95). Correspondingly, the Berger-Parker dominance index (d) had the lowest value where equitability was highest.
In the first two years after their installation, the two PSRCs had different GBAs, a fact due – most likely – to different site conditions. These assemblages were more similar to those in agricultural crops or nearby pastures than to those in PFRFs. However, they were (with one exception) significantly different from those in the other habitats. Further investigations, conducted after a greater number of years since the establishment of PSRCs, are needed to assess their impact on the composition and diversity of carabid assemblages.

Keywords
ground beetle assemblages; structure and diversity; poplar short-rotation coppices; wheat and rapeseed crops; pastures; periodically flooded riverside forests.

Assessing the potential distribution of the invasive species oak lace bug in Europe: a species distribution modelling approach

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Abstract

Biological invasions pose a significant threat to global ecological and economic stability. The recent arrival and subsequent spread of North American species *Corythucha arcuata* (Say 1832), commonly known as the oak lace bug, across 24 European countries within two decades indicates its potential establishment as a major pest for European oak communities. It could negatively impact their growth, vitality, and reproductive success in both the short and long term. To effectively understand and manage its environmental impact, it is crucial to conduct a comprehensive assessment of its current and potential distribution in Europe, including identifying risk areas for its spread. To achieve this, we collected presence data from 19 countries, which involved a variety of data sources including expert observations, citizen science and GBIF data, all of which were verified by national experts. Employing machine learning techniques, we built a species distribution model for current and future climate conditions, incorporating the distribution of host species as a covariate. To account for the non-equilibrium of the invasive species with the environment, we performed environmental systematic sampling and removed the generated absences that were environmentally close but geographically distant from the presence data.

Our results highlight the dual role of both climate and host species in driving the distribution of the oak lace bug in Europe with the potential distribution of sessile oak and Turkey oak as important predictors. Currently, the species is limited to the southern part of Europe, but the species migration capacity, climate change and its potential host migration will likely support the colonization of new territories in Central and North-eastern Europe.

Our study provides a comprehensive presence dataset for the oak lace bug at this moment, as well as a dataset of the current and potential distribution under different climate change scenarios. This is an important and relevant tool for forestry and environmental science professionals who are working to develop integrated monitoring and pest management strategies that protect both forest ecosystems and human health.

Keywords

Corythucha arcuate; species distribution model; invasive alien species; climate change;

Diversity of coleopteran species in different forest development stages

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Abstract

Biodiversity, in its simple form, measures the species richness within an ecosystem. However, different species have different habitat requirements and the change in forest conditions is expected to drive a change in species composition (i.e., biodiversity). Although such changes are caused by the natural dynamics of the forests, the society in general believes that this is only a result of human activities and always leads to biodiversity decrease (or degradation). Therefore, we aimed to assess how the features of the forest ecosystem like size, age, location, or even degree of anthropization influence the biodiversity richness and patterns. Through specific indicators and parameters, within this study, we aimed to highlight the diversity of species from the main coleopteran families in different forest habitats. The specific objectives of the study were: i) identification and establishment of the specific composition of the Coleoptera groups; ii) analysis of the diversity and structure of coleopteran complexes; iii) highlighting rare and endangered species; iv) identification of saproxylic Coleoptera species. For this, forest stands in different development stages were chosen, both under management and protected. We therefore choose six different forest habitats, from which five are under active forest management and cover different development stage (from young regeneration to old forest) and an old forest within a forest reserve - all located in Central Romania (Postavaru massif, Brașov county). The plots were placed in a mountain region at elevations between 800 and 1150m in naturally regenerated stands dominated by European beech (*Fagus sylvatica*), Norway spruce (*Picea abies*) and silver fir (*Abies alba*). Other less represented tree species include Scots pine (*Pinus sylvestris*), sycamore (*Acer pseudoplatanus*), hornbeam (*Carpinus betulus*), elm (*Ulmus glabra*), and sessile oak (*Quercus petraea*). In these areas, at the beginning of the growing season of 2022, we installed 18 (IBL-2) diversity insect traps (six traps in each plot) for intercepting the beetles during flight. They were disposed schematic, of a geometric pattern at distances of 25-30m between them. Every two weeks, all the traps were checked and the trapped insects were collected and preserved by freezing for further determination. The identification was made in the laboratory, under a stereoscopic microscope analyzing the features, specificity and particularities of each taxa (body shape, mouthparts, antennal shape, tarsi formulas, shapes of segments, etc) using the latest identifications keys. Communities of captured beetles were assessed with descriptors like: dominance, constancy, and ecological significance (Dzuba index) while estimation of species richness was performed with the richness estimator index. Diversity analysis was based on: Shannon, Simpson, Evenness, and Berger–Parker indices. Results: we highlighted significant differences in both abundance and number of species between all forest habitats (stand development stages and degree of anthropogenic intervention); for some insects group we noticed a distinct correlation of the abundance with the main features of the stand: composition, crown canopy, age, and dead wood presence which are directly related with the forest management and forest development stage. Moreover, our findings indicate the presence of rare and endangered species: *Rosalia alpina*, *Cucujus cinnaberinus*, *Rhysodes sulcatus*, *Prostomis mandibularis* as well invasive alien insects like ambrosia beetles *Xylosandrus germanus*, or sycamore lace bug *Corrytuca ciliata*.

Keywords

insect diversity; forest management; biodiversity conservation; forest development stage; endangered and rare species.

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Abstract

The decline of forest ecosystems health, reported in the early 1980s, has been mainly caused by the interaction of atmospheric pollution and various biotic and abiotic factors as well as other disturbances, such as anthropogenic disturbances or fires. To identify, analyze and monitor the degradation and disruption of forested ecosystems across Europe, foresters and forest scientists have developed specific methods and procedures for continuous monitoring of the factors which influence the quality of forested ecosystems and specifically across Europe, the forest monitoring system [1].

Plants are a major component of forest ecosystems. They are the source of primary production, controls the atmosphere gas exchanges, playing a direct role in water and nutrient cycling, as well in climate and microclimate. Plants influences soil characteristics, and interacts strongly with other biotic components and they are determinant habitat for many species.

The plant diversity characterized by composition and structure can serve as bio-indicators for pollution and environmental changes to forest ecosystems and has also been identified as a specific target for the calculation of critical loads/levels. Plant diversity patterns result from ecological and evolutionary processes acting at different spatial and temporal scales [5].

The Romanian Forest Monitoring Systems through "Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, part. VII" [3] in Level I and Level II ICP Forests monitoring networks and through "Manual on the methodology for long-term monitoring of the state of forest ecosystems under the action of atmospheric pollution and climate change" [2] in LTER Romania sites provide a consistent methodology to collect high quality, harmonized and comparable data.

The plants assessment within the Romanian forest monitoring networks, 484 georeferenced sites, totals a number of 381 species, of which 363 species of vascular plants (20 species of ferns and 343 species of angiosperms) and 18 moss species. Of the total species, 182 plants (48%) are specific forest ecosystems [4], 34 taxa (9%) are characteristic for forest edges and thickets, and 69 taxa (18%) are species that have migrated in the forest from the neighboring meadows. Ruderal species are also present 39 taxa (10%) due to various anthropo-zoogenic factors (e.g., tourism, grazing, exploitation of forest resources, etc.). The remaining 57 taxa (15%) are species characteristic of some azonal habitats, such as rocks, weeds, heights, springs and marshes.

From a systematic point of view, these species belong a number of 236 genera and 67 families (10 mosses, 3 ferns and 54 angiosperms). In the case of angiosperms, the best represented in percentage more than 5 % are the families *Asteraceae* 15.16%, *Poaceae* 10.2%, *Lamiaceae* 7.28% and *Ranunculaceae* 5.53%.

The information about morphology, ecology, area, similar taxa, etc., about these plant species and the collected photographic material were the basis for the elaboration of an illustrated guide "Plants identified in the herbaceous cover in the forest research and monitoring networks existing in Romania".

Keywords
forest; monitoring; plants; alfa-diversity; bio-indicator;

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Session 4 Improving and preserving the genetic diversity of forests - ORAL PRESENTATIONS -3rd of October 2023

KEYNOTE SPEAKER

Chairs

Oliver GAILING
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Adaptation of forest trees to changing environmental conditions

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Abstract
Forests are dominating terrestrial ecosystems and provide essential products for human use. Global climate and land-use change results in natural disturbances and fragmentation threatening the health and productivity of forest ecosystems. Genetic variation in traits associated with survival and reproductive success (adaptive traits) is the basis of long-term evolutionary adaptation to these changing and stressful environmental conditions. Adaptive traits are generally controlled by many genes with relatively small individual effects. This polygenic architecture in combination with the generally high genetic variation in forest trees can facilitate the adaptation to new environments, but it is unclear whether it will allow them to cope with the currently rapidly changing climatic conditions. On the other hand, trees show considerable phenotypic plasticity. Often epigenetic changes, altered gene expression without changes in the DNA sequence, underlie phenotypic plasticity enabling the expression of different phenotypes of individual genotypes in response to changing environmental conditions. Examples of our current research are presented to describe the genetic architecture of adaptive traits and signatures of local adaptation in dominant European forest tree species. The relative contributions of genetic and epigenetic variation to phenotypic trait variation and to short and long-term adaptation are discussed. Understanding the genetic basis of adaptive traits and monitoring adaptive genetic variation in natural populations is necessary for the development of breeding and management strategies in the face of climate change.

End2End flow: an applicable solution to lift genetic monitoring programmes implementation

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Abstract

Genetic monitoring represents a conservation basis by revealing transformation in populations' genetic diversity, assisting proactive management, and guiding directed gene flow, with the potential to assist in assessing predicted and realized impacts of climate change. Efforts to increase capacity for genetic monitoring need significant political and financial support, but mainly proper information infrastructure development. In 2021, an enormous effort focused on assessing the genetic structuring of the brown bear population in Romania started with the premise of collecting and analyzing at least 18000 faeces samples at the national level, with approximately 600 people involved. The effort required large logistics, and using traditional methods was not an option because it was an open gate for human errors and process blockages. To our knowledge, we report the first genetic monitoring effort with E2E flow worldwide. This software platform provides an end-to-end solution for efficient and comprehensive management of multispecies biological samples, ensuring sample tracking, analysis, and preservation throughout the entire lifecycle, including biological banking indexing. It consists of a mobile app used in the field for inventory actions, a database, a REST web service as a backend, and a WEB frontend for laboratory processes, map tracking, statistics, and results interpretation. With this platform, researchers and conservationists can streamline the management of wildlife species biological samples, enabling easy sample tracking, data integration, and advanced analytics for enhanced wildlife research and conservation efforts with an easy and intuitive report to be generated for the authorities to be reported under the Convention on Biological Diversity.

Keywords

genetic; monitoring; wildlife; population.

Use of DNA analyzes for verifying and identifying the origin of Forest Reproductive Material

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Abstract

The level of genetic diversity of trees is crucial for the adaptation of forests to climate change and for sustaining forest ecosystems. It is widely assumed that populations characterized by narrow genetic diversity could be more sensitive to environmental changes or disease, thereby leading to a decrease in productivity. Knowledge about the genetic structure of forest tree species populations is very important in order both to maintain the ecological stability of forests and for the optimization of timber production. To verify the polymorphism and diversity of forest tree populations microsatellite marker analyses have been used in the FGMRI laboratories. The genetic differentiation between autochthonous and introduced populations from the Czech part of the Giant Mts. and among autochthonous populations of the Tatra Mts. of *Pinus mugo* was analysed by 12 nuclear microsatellite markers. Analyzes of microsatellite markers were performed on 697 samples of *P. mugo*. Measuring the size of amplification products was carried out using the genetic analyser Applied Biosystems 3500. The obtained data from fragmentation analyses were processed by the statistical programs (GenAlEx 6.503, Cervus, Structure etc.) to obtain genetic characteristics, especially an overview of the level of genetic diversity, heterozygosity, genetic differentiation genetic compositions, and genetic distance of monitoring subpopulations. The obtained profiles of monitored subpopulations from different locations and different origins (autochthonous and introduced) were distinguishable from each other. Based on the analyses of 12 SSR loci, the autochthonous subpopulations from the Tatra and Giant Mountains were different. The introduced subpopulations in the Giant Mountains were genetically similar to the subpopulations from the Tatra Mountains. SSR analyzes were used for determination and for verifying the declared genetic origin of reproductive material of 3 forest species (Norway spruce, Scots pine and European beech) in terms of the Czech Republic. Monitoring of the identity of reproductive material was realized during three or four years, i.e. from seed collection to the production of transplanted plants. Seven, seven and nine optimally polymorphic markers with sufficient informative value were selected for the subsequent evaluation of the genetic structure of the monitored sets of Norway spruce, Scots pine and European beech reproductive material by Bayesian clustering. Analyzes of microsatellite markers were performed on 1920 samples of the 32 sets of Norway spruce reproductive material originating from 8 selected sources of forest reproductive material (units of forest reproductive material), 2390 samples of the 40 sets of Scots pine reproductive material from 10 selected sources of forest reproductive material and on 1702 samples of the 30 sets of European beech reproductive material from 10 selected sources of forest reproductive material (units of forest reproductive material). The obtained genetic compositions of sets were compared after statistical processing. Using the performed Structure analysis, the obtained profiles of monitored units of reproductive material of different origins were distinguishable from each other. The methodological procedures could be used in the state control systems for verifying the declared origin of forest reproductive material and to increase consumer protection of forest owners and nursery producers in the Czech Republic. The developed procedures of genetic monitoring by SSR markers could be used in the amendment of forestry legislation and in state subsidy policy in the area of protection and reproduction of forest tree gene resources in the Czech Republic.

Keywords

genetic diversity; forest reproductive materials; microsatellites; Norway spruce; Scots pine; European beech; dwarf mountain pinewood.

Acknowledgments

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Phenotypic variability and plasticity of European beech (*Fagus sylvatica*) provenances tested in Romania

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Abstract

In the near future, it is predicted that the natural distribution range of forest tree species will be reshaped due to the rapid changes in climate conditions. Drought is one of the climate factors that produce disturbances in the natural stands, and drought-sensitive species can be replaced at the limits of their natural distribution range by more drought-tolerant species. The assisted migration of the species in favourable ecological and climatic conditions, as future solutions for the forest sustainable development, could be decided especially by genetic tests.

This study aims to evaluate the adaptive potential of European beech (Fagus sylvatica) across two different sites in Romania by assessing the growth and stability performances and the phenotypic plasticity of the 31 international beech provenances tested in two common garden experiments (Alesd and Fantanele). For growth and stability performances, tree height (Th), breast height diameter (Dbh), and survival (S) were measured. The phenotypic plasticity (PP) of provenances was evaluated using the relative distances phenotypic index (RDPI).

In the ecological optimum for beech, the mean S, Th, and Dbh were higher by 8%, 8%, and 6%, respectively, than at the eastern limit of the beech distribution range (significant differences). The highest mean of PP was obtained for provenances Plateaux du Jura (France), Grasten (Denmark), and Perche (France), which seem to have a higher capacity to adapt to different environmental conditions.

Only three provenances performed better in both trials (Perche-France, Eisenerz-Austria, and Maglij-Bulgaria). Considering the significant difference between testing sites and the contrasting reaction of some provenances, which reached high performance in one trial and low performance in the other, it is recommended to use the best-performing provenances only in the provenance region where these provenances obtained a good performance. Even the Romania provenance (Bihor) reinforces what was said above (was included in the best-performing provenances group only in the Alesd trial, where it is also the local provenance, while in the limiting climatic conditions of Fantanele, it obtained modest growth results but once again a good survival).

Keywords

European beech; provenance trials; phenotypic plasticity; adaptive potential; growth and stability performances.

Preliminary assessment of genetic gain through the selection of provenances of Douglas fir (*Pseudotsuga menziesii* Mirb. Franco) in the provenance test in Bosnia and Herzegovina

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Abstract

Douglas fir is a type of very high productivity that has shown very successful growth in the territory of Bosnia and Herzegovina. This research aims to determine the heredity and production potential of the Douglas fir from 5 provenances in the Bosnian-Herzegovinian provenance test through the genetic gain of thickness and height growth. The results will be used in the selection of the best provenances in terms of genetic gain.

For this research, the height and root collar diameter of Douglas fir plants in the provenance test Batalovo Brdo were measured in 2022 (60-year-old trees), and basal areas and volumes of trees were calculated. The provenance test was established in 1966, by planting 2+2-year-old seedlings and including five provenances. Heredity (in a broader sense) and selection differential for provenances were assessed using analysis of variance. Possible genetic gain if using five best and one best trees per provenances were determined. Possible genetic gain for diameter at breast height if using five best trees/one best tree was from 0.7%/0.8% for provenance 65-1.0 to 35.2%/39.2% for 83-3.0. Possible genetic gain for height if using five best trees/ one best tree was from 5.6%/5.96% for provenance 65-1.0 to 33.2%/34.9% for 12-2.0. Possible genetic gain for the basal area if using five best trees/ one best tree was from 26.3%/28.1% for provenance 25-1.0 to 56.92%/59.6% for 11-0.5. Possible genetic gain for volume if using five best trees/ one best tree was from 28.3%/31.0% for provenance 83-3.0 to 75.2%/83.2% for 11-0.5.

The obtained results can be used in the introduction of green Douglas-fir to suitable habitats in Bosnia and Herzegovina, where it is recommended to use reproduction material from the best trees of provenance 11-0.5 in order to achieve the highest possible genetic gain.

Keywords

Douglas fir; provenances; heredity; genetic gain.

Multi-trait provenances and progeny variation in European beech (*Fagus sylvatica* L.) trials in the north-eastern part of Romania

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Abstract

European beech (*Fagus sylvatica* L.), one of the main tree species in Central Europe and the most widespread species in Romania, is thought to be threatened by the predicted future temperature changes. Since natural regeneration of beech has been used almost exclusively in our country, there are currently no programs for improving or testing the genetic values of seed sources, although the selection of the right seed sources is the guarantee for the success and adaptation of the plantations. Here, we present a multi-trait provenance and progeny trial analysis of two field sites located at different altitudes 880 m.a.s.l (Demacusa field trial) and 550 m.a.s.l. (Vidra field trial) established in 2013, including 12 natural populations of European beech, covered the north-eastern native species range in Romania. Our goal was to find patterns of genetic variation in survival, collar diameter, height (2021, 2022), stem form, forking, and spring phenology, and to associate these with seed source environments. In order to identify the variance components caused by local influences, height increments were calculated and microsite effects on provenance performances were observed, showing a highly significant provenance-by-block interaction in both trials. According to the survival and best growth and stem quality outputs the provenance effect was significant, the best provenance in both trials registering only in terms of survival, respectively Solca and Văratec provenances. The results could be used to establish the appropriate seed sources and to better understand how various provenances are responding to climate change.

Keywords

European beech; climate change; provenance trials; genetic variation; seed sources.

Genetic variation and inheritance of the quantitative traits in *Quercus frainetto* progeny trials in Romania

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Abstract

The Hungarian oak (*Quercus frainetto* Ten.) is a forest species native to the Mediterranean area, southeastern Europe, and Asian Turkey. In Romania, it reaches the northern limit of its natural range and has its largest distribution in the southern part of the country. It occurs in plain and forest-steppe areas and can grow on low-productivity sites with highly compact soils improper for other oak species. Recent researches highlight a general shift towards warmer and drier conditions in the last decades in Romania. The aridity process of some regions in Romania, especially the south of the country, will increase in the future and considerably alter the forest species' growing conditions. Among the most affected by climate warming are the pedunculate oak forests. Therefore, urgent measures for adaptive management are necessary, such as replacing sensitive species with others better adapted or selecting forest reproductive material with high adaptive capacity. To address these problems, the objectives of this study were to: investigate the genetic variation of growth traits, stem straightness, and survival in two open-pollinated progeny tests of Hungarian oak; determine the heritability and genetic parameters; assess age-to-age genetic correlations; asses genotype x environment interaction, and evaluate the potential for selection. Results highlighted high genetic variation for quantitative traits and survival in both progeny tests. A highly significant effect of provenance, family, and locality was found. The individual heritability was higher than the family mean heritability. Also, significant genetic correlations were obtained between quantitative traits in both tests. Results are extremely important in the species breeding program, conservation of forest genetic resources, and reforestation activity, especially for transferring forest reproductive material to improve species adaptability to climate change and wood production.

Keywords

Hungarian oak; quantitative traits; heritability; genetic correlations; genotype x environment interaction.

Selection of Norway spruce (*Picea abies*) provenances from Romanian provenance trials based on multi-trait and stability

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Abstract

Covering a distribution area of approximately 30 million ha (38% of the total coniferous species area), Norway spruce (Picea abies (L.) H. Karst.) is an important coniferous species in Europe. In recent studies, it was shown that Norway spruce is sensitive to water deficit and increasing temperature. The aim of this study was to select Norway spruce provenances with high and stable performances in three provenance trials established in Romania. The trials were established in 1972, and 81 provenances have been tested. The traits assessed were: total and pruned height, diameter at breast height, and survival rate. The selection was based on the multi-trait stability index (MTSI). For a selection intensity of 15% (12 out of the total 81 provenances), the selection differential was between 6.42% (for diameter at breast height), to 17.80% (survival rate) better than site means. The results serve as important information for the genetic improvement program and the guidelines for seed transfer based on assisted migration for this meaningful, both ecologically and economically, forest tree species.

Keywords

Norway spruce; stability, multi-trait; provenances; selection.

Implications of phylogeographic studies in the conservation of Forest Genetic Resources in Romania, Bulgaria, and the Republic Of Moldova

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Abstract

The molecular diversity of forest genetic resources of *Tilia cordata*, *Quercus pubescens*, and *Q. pedunculiflora* in Romania, Bulgaria, and the Republic of Moldova has been investigated using PCR-RFLP, cpSSRs, and nSSRs molecular markers. The occurrence of cpDNA haplotypes reveals phylogeographic patterns that provide insights into evolutionary processes within the eastern region of the Balkan Peninsula and the southeastern marginal range in Europe. Using genetic data to delineate seed zones is a promising and innovative approach to forest management. Delineating seed zones for forest species based on chloroplast DNA genetic diversity can support the preservation of their evolutionary potential, ensuring their resilience and adaptability in the face of environmental changes. The integration of standing genetic variation and the importance of implementing forest genetic monitoring in forest genetic resources are discussed as essential components of conservation recommendations.

Keywords

Forest genetic resources; Quercus pubescens; Quercus pedunculiflora; Tilia cordata; standing genetic variation.

Acknowledgments

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Towards advanced-generation seed orchards of European silver fir in Romania

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Abstract

The European silver fir (*Abies alba* Mill.) is one of the most important conifer tree species in Europe. In Romania, it is a main component of mountain forests and has manifold ecological, economical and soil protective functions. Environment changes will pose severe pressures for European silver fir populations. Therefore, producing the improved forest reproductive material, which has high growth and adaptive capacity, for regeneration and afforestation program is required.

In Romania, there are 92.1 ha of first-generation seed orchards of European silver fir, which comprise vegetative copies of plus trees selected in natural populations. The seed orchards are 40 years old; therefore, establishing the second generation of seed orchards is necessary.

To address these problems, since 2007, an advanced-generation breeding plan for European silver fir has been started. Eight progeny tests based on both controlled and open pollination have been established, to evaluate the breeding value of the plus trees from the first-generation seed orchards.

The objectives of this study were: to investigate the genetic variation of the quantitative traits into two full-sib and six half-sib progeny tests of European silver fir at ten years old, to determine and to compare the genetic parameters from control-pollinated and open-pollinated progenies, to assess the genetic correlations among traits, to determine the genetic gain under different breeding strategies and to evaluate the gene diversity and relatedness among candidates for optimizing genetic gain in relation with genetic diversity.

Results will have extreme importance in the species' breeding program. These will complete the first breeding generation of European silver fir in Romania and will be necessary to advance to the second breeding generation.

Keywords

European silver fir; genetic parameters; genetic gain; combining ability; genetic diversity.

Spring and autumn phenology monitoring in European beech (*Fagus sylvatica*) in the Carpathian Mountains using UAVs images and Copernicus biophysical parameters

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Abstract

European beech (*Fagus sylvatica*) is one of Europe's most common forest tree species, it also covers the largest area of Romania's national forest fund, and it has great ecological and economic potential, so a better understanding of how this species is responding to climate change effects is essential. Phenology can be a biophysical key to understanding plant life cycle events in current climate disturbances and help foresters make the right decisions for smart climate forest management. Field observations of tree phenology offer valuable information regarding tree-level monitoring, but they are labour-intensive. Remote sensing is a promising technique that offers fast, accurate, and unbiased results for phenology monitoring. We carried out phenological observations on European beech in five study sites, along an altitudinal transect, from 550 m to 1450 m. The methodology proposed by Vitasse was used during the fieldwork. Simultaneously with the field observations of trees' phenological state in two studied sites, aerial images were collected using an RGB sensor mounted on UAV, which was further processed into vegetation indices. Five biophysical parameters based on the Copernicus satellite program were collected for a similar period to the ground observations. We studied the time series correlations between ground data and remote sensing observations (GLI r = 0.86 - UAV and FCover r = 0.91 – Copernicus biophysical parameter) and identified the most suitable vegetation indices (VIs). We trained linear and non-linear (random forest) models to predict the leaf phenology as a percentage of leaf cover on test datasets. The models had reasonable accuracy, RMSE percentages of 8% for individual trees, using UAV, and 12% as an average site value, using the Copernicus biophysical parameters. Our results suggest that the UAVs and satellite images can provide reliable data regarding leaf phenology in the European beech, and they can drastically reduce the effort needed to undertake phenology observations.

Keywords

European beech; leaf phenology; field observations; remote sensing; vegetation indices; UAVs; Copernicus biophysical parameters; machine learning prediction.

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Abstract

Ophiostoma novo-ulmi, *Cryphonectria parasitica*, and *Hymenoscyphus fraxineus* were among the most dangerous forest diseases. The aim of the present research was to identify the forms of tolerance/resistance of the forest hosts (*Ulmus* spp., *Castanea* spp., *Fraxinus* spp.) to these invasive fungi. Monitoring of resistance was pursued in long-term experimental plots. Among the elm species, *U. glabra* was extremely sensitive (almost no tolerance in the 30 years of testing), *U. minor* was sensitive (intense dieback, but many trees are still viable), while *U. laevis* was very tolerant (infected but without significant mortality). The Romanian genotypes of *C. sativa* are extremely sensitive to *C. parasitica* (mass dieback, no tolerant specimen identified), while the horticultural varieties/hybrids (*C. crenata* x *C. sativa*) are very resistant. Among the monitored ash trees, *F. excelsior* proved to be very sensitive to *H. fraxineus* (almost total drying in wet seasons), *F. pennsylvanica* is tolerant (with infections but without significant drying), and *F. ornus* is resistant (weak infections, without dryness).

Keywords

Ophiostoma novo-ulmi; Cryphonectria parasitica; Hymenoscyphus fraxineus; Ulmus glabra; U. minor; U. laevis; Castanea spp.; Fraxinus excelsior; F. pennsylvanica; F. ornus; breeding.

Session 5 Wildlife conservation and management - ORAL PRESENTATIONS - 3rd of October 2023

KEYNOTE SPEAKER

Chairs

Náhlik ANDRAS
General Deputy rector, Soproni Egyetem - Institute of Wildlife Management and Wildlife Biology
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Ungulate management and forestry - ecological and economic aspects

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Abstract

The selection pressure of the large herbivores formed the evolutionary shape of plants (piliferous stem and leaves, spines), their dynamics (r-selected plants) and often their physiological functioning (flavor and toxins). In most of the temperate natural ecosystems, the density of large herbivores is relatively low even besides the lack of human influence because their populations are affected or regulated by density-dependent (food supply, diseases, in some cases predation) and independent (temperature, precipitation) factors or even by social behavior (territoriality). Regarding the relationship between forests and ungulates in natural ecosystems, case studies show that herbivores have a little effect on the short-term dynamics of plants, on their species composition and/or dominance relationship. Herbivores consume less than 10%, but characteristically only 5% of the primary plant production and even a small proportion of that consumes large mammalian herbivores. However, the multifunctional concept of commercial forests, even if they are protected at different levels, leads to conflicts between interest groups preferring particular functions, such as economic function, recreation and soil or water protection. Damage caused in afforestation and reforestation is problematic because the density of ungulates is increased artificially and the object of their feeding is the cultivated commercial and/or protection forests. Therefore, in cultivated forests, the overpopulation of ungulates leads not only to economic damage but also to ecological one. Although damages caused by ungulates in forests are usually much lower than those characteristic for crops, if taking into consideration also the measures taken to prevent the damages, i.e. protection of the forest regeneration compartments, the costs are often comparable. The presentation aims at analyzing the effect of ungulates' feeding on forests on both the level of single trees and the stands. It discusses the forms of the damages, the ecological and economic effects and deals with the factors affecting the extent of damages.

The impact of the extreme conservation measures of the brown bear population in Romania in the evolution of human-bear conflicts in the period 2015-2022

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Abstract

The bear in Romania is in a favorable conservation status, densities that place it on the first places in the world, well above the optimal density, an exceptional genetic variability similar to that of northern Canada and Alaska, and a productivity well above the European average. Currently, the bear population in Romania is estimated at 8,093 specimens (according to the 2022 data provided by MMAP). The largest numbers of bears are estimated in Mureș, Neamț, Harghita, Covasna, Brașov and Buzău counties. The bear population in Romania is one of the largest in Europe, representing approximately 40% of the European population. The unjustified suspension of bear hunting in 2016, under the pressure of extremist NGOs, led to an escalation of man-bear conflicts.

During the period analyzed in the study, cumulatively by large categories, a number of damage files were reported in 3 sectors: agricultural, livestock sector and multiple damages. The largest share is in the livestock sector of 60.7%, 20.1% in multiple damages and 19.25% in agricultural crops. The spatial analysis of the damage caused by the bear species demonstrated that if in 2015-2016 the reported damages were only in 5-7 counties, in 2022 they were present in 23 counties.

Keywords

bear; conflict; conservation; damages.

Non-invasive samples and approaches in challenging conditions of large populations: a case study of brown bears (*Ursus arctos*) in Romania

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Abstract

The increasing population of brown bears (*Ursus arctos*) in the country's territory requires reliable monitoring methods to establish long-term conservation strategies. Non-invasive genetic sampling techniques from faeces have allowed the sampling of small and large populations and using microsatellite markers for determining population structure, effective population size, demography, and history. Here, we tested multiple preservation, extraction, and amplification methods for faeces to detect suited procedures applicable to large sample sizes and to enhance genotyping of unique individuals beyond the current standard protocols. Out of four preservation methods (Ethanol, Lysis buffer, Solid fresh, Isohelix StoolFix buffer), the best performer was Isohelix StoolFix buffer, with the best architecture in terms of storage conditions, tube size, sampling procedure and laboratory analysis. The Isohelix DNA extraction kit, optimized for the StoolFix buffer, registered a high percentage of successful electropherograms. However, this extraction kit was nontransferable to our Hamilton robot entitled for analyzing large amounts of samples in short periods. The Omega Mag-Bing DNA kit was the second performer in DNA purity, representing a suitable alternative for the Hamilton robot.

In the second step, we tested Quanto and Qiagen PCR amplification enzymes for the samples stored in the Isohelix Stoolfix buffer and extracted using the Isohelix BuccalFix Dna Isolation kit. Qiagen performed well, while Quanto enhanced highly degraded DNA samples, reducing the background noise, and increasing the reading scale with up to hundreds of base pairs. In conclusion, our findings established an asset for collecting and ensuring the sound quality of the non-invasive DNA samples adapted to local conditions and existing infrastructure. Implementing the sampling by enrolling many people to collect a tremendous number of samples (estimated to be approx. 24000) requires a simple, easily applicable, and adapted protocol to local conditions. However, our approach responds to extensive population non-invasive monitoring challenges and ensures a proper collection, quality and analysis that respond to practical needs.

Keywords

non-invasive genetic approaches; Isohelix Stoolfix buffer; population genetics; brown bear population.

Perspectives for Human-Wildlife Incidents and Accidents in Romania

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Abstract

Wildlife conservation is challenging, primarily when species provoke attacks on humans and damage crops, thus being a nucleus of concern for decision-makers. Most incidents between people and wild animals, especially with large carnivores (bears and wolves), occur in hot spots with high densities. Usually, this issue results from rural communities or camping spots near wildlife habitats. Human-wildlife incidents are a well-known phenomenon worldwide, and different species may cause different types of injuries at different times of the year. Wildlife vehicle collision is another subject of interest; roads are a source of mortality, especially for large mammals and act as a barrier. To ensure human-wildlife coexistence and long-term benefits, as well as prevent conflicts, wildlife species management and strategies must be optimized.

However, it is necessary first to analyze the compensation scheme for human-wildlife incidents and accidents, which includes current practices, legislative structure, and scientific literature. We have organized several meetings with the stakeholders and decision-makers in wildlife damage management to discuss the entire process. As the primary solution, we found that digitalization will enhance the implementation of a proactive database for prevention. Because the process involves many actors, the current legislation must implement practical measures such as a solution to mitigate road kills by investing in a prevention system (''virtual fence''; ''animal vehicle prevention system''). One of the most important measure to mitigate road kills seems to be the virtual fences and/or animal vehicle prevention system, which keeps the wildlife of the road.

Keywords

human-wildlife conflicts; digitalization; road-kill.

Educating wildlife: intelligent solutions for animal-vehicle collisions mitigation

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Abstract

Wildlife faces more and more challenges in moving around habitat patches due to human rapid development. Car accidents with wildlife species, combined with habitat loss, are one of the major threats to biodiversity. Humans must pay for the damages that occur during an accident, and wildlife species get injured or killed, but sometimes human lives are at risk when facing a large animal. It is essential to understand the mechanism determining wildlife species to cross the roads, the costs, and how to mitigate these problems. An essential and effective tool to achieve all of these is road ecology. In the past four years, we have conducted a study in Eastern Europe, Romania, in the county Brașov, on three major roads (DN1, DN1A, DN13), DN1 being one of the busiest roads in Romania. We used two different approaches; one consisted of determining the wildlife to use the existing crossing infrastructure (regular bridges) by readapting the entrances and the vegetation nearby, and the other method was to install devices that can deter the wildlife from staying on the road surface (virtual fence and AVC-PS system). We have registered more than 1000 wildlife crossings under the readapted bridges in less than one year, and no accidents in the area of the virtual fence (after 2 years from the installation) and the AVC-PS (after 6 months), which can be translated in the same number of accidents being avoided. From the pictures of mothers with cubs who are using the areas we have made interventions to cross the busy roads, we can conclude that in time individuals will learn which are the safe places to cross, and the number of accidents with wildlife will be lowered.

Keywords

wildlife; road ecology; virtual fence; brown bear; road safety.

History of photo trap camera as a survey tool for wildlife

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Abstract

This study provides an historical review of the methodological and technological evolution of camera trapping as a wildlife survey tool. Camera trapping has a long history, but less time has passed since it is used as a wildlife monitoring method. James Muybridge first used what modern biologists would consider now a "camera trap" in the USA between 1878 and 1884. By the mid-twentieth century, smaller photographic equipment, and the improvement with flash bulbs allowed further refinement of remote wildlife photography. At the beginning, the concerns regarding the use of photo trap camera were the achievement independent and multiple captures of images with the best possible quality, later with the technological development these concerns took the second place, the techniques and methods of collection and integrated analysis of data becoming a priority. The scientific publications analyzed highlighted the evolution of the use of photo trap cameras from simple presence-absence studies to very complex monitoring studies that include aspects of population ethology, ecology, and estimation, as well as combined wildlife monitoring methods. Current scientific research is concerned with improving and standardizing data collection and analysis methods so that scientifically rigorous results are obtained. The current interest of researchers regarding the use of photo trap cameras is to use expensive equipment that offers higher speed, greater functionality, more reliability, and the ability to interconnect via the internet with other technical measures.

Keywords

photo trap camera; wildlife monitoring; data collection; data analysis; wildlife survey tool.

The brown bear (*Ursus arctos*) damage compensation process and stakeholders' analysis in Romania

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Abstract

In the context of human population increase, the intensification of agriculture, the development of road and housing infrastructure, human-wildlife conflicts, and the damages they produce, represent a critical issue, especially in hot spots, where bear densities are high. However, declining tolerance and negative attitudes towards the species causing conflicts are the main threat to their long-term conservation. The principles underlying coexistence, with direct implications and long-term benefits, stem from predicting and preventing conflicts and implementing species management, pro-active policies, and strategies. To ensure scientifically based mechanisms, increase decision-making transparency and create institutional tools, a critical stage is the analysis of the existing damage compensation scheme and management, including accidents and human-bear incidents, at national and international levels, by assessing the literature, legislative framework, and current practices. Thus, during the meetings with all groups of stakeholders, the stakeholders and decision makers involved in the wildlife damage management were consulted and their role in the existing legislative framework was analysed. The optimization and digitalization steps were substantiated by revising current legislation, applying tailor-made questionnaires, and conducting interviews. As a primary concern, a high need for process digitalization has been identified. As the process involves numerous actors and bureaucracy, the legislation must be improved and adapted to the needs identified in practice. The main actors should have a voice in legislation drafting and process optimization. Moreover, instead of reacting to problems, investing in prevention should be the norm, to mitigate the amounts that at the moment, result in high compensations paid by the state to damaged parties.

Keywords

damage compensation scheme; brown bear; stakeholder analysis.

Habitats analysis in the Letea and Caraorman fields, with a view to repopulation with red deer (*Cervus elaphus* L.) and fallow deer (*Dama dama* L.)

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Abstract

The maintenance and enhancement of the biodiversity in the Danube Delta, using mainly conservation measures on one side, and the opportunities presented thus successfully reintroducing the extinct species of the Danube fauna, formed the background for the expatiation of this study.

Following a thorough habitat analysis, two areas located in the eastern part of the Danube Delta have been designated, particularly territories administered by the municipalities of C. A. Rosetti – Grindul Letea, respectively Sfântu Gheorghe – Grindul Caraorman.

There has been some archaeozoological and toponymic evidence of the presence of red deer in the past (Deer Grind e.g.), but the numbers were certainly limited.

Both of the targeted species have been morphologically and ethologically profiled, in order to assess in a prosperous way, the impact that this initiative will have, in compliance with the administrative and ecological necessities of the area. The assessment in relation to the trophic potential of the habitats reflected by the suitability, has been implemented through the use of environmental diagnostic keys, while ascertaining the potential number of animals that the habitat can withstand. To such a degree, the improvement of ecological and social aspects embodies the targeted goal whilst impacting on the area, subsequent scenarios in this respect being desirable. Taking into account that the studied areas belong to a certain reservation and considering as well the allochthonous origin of the species, it has been recommended to avoid populating this territory with fallow deer (*Dama dama)*. In the Letea forest, 90.2% of the total surveyed area of approximately 27,400 hectares is unsuitable for the population of either of the two proposed species. The remaining of 9.8% is likely suitable in this purpose, whereas 900 hectares of this surface could be populated with a nucleus of 5 to 9 individuals. The carrying capacity can be greatly improved by eliminating domestic species, which lead to a significant decay of natural habitats. Considering the circumstances in the Caraorman forest, it is proposed to initiate a pilot experimental study targeting the re/introducing of an initial nucleus of 9 red deer (4 males and 5 females), which will be closely monitored upon release using GPS-GSM devices, with an estimated number of 14-17 animals. Consequently, the close monitoring of the population is intended over a period of 20 years.

Keywords

Cervus elaphus; Danube Delta; conservation; reintroduction; diagnostic keys.

Habitat suitability and potential range expansion for Eurasian beavers *Castor fiber* in Europe

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Abstract

Reintroduction and rewilding initiatives are key strategies to reverse human impacts on wildlife and re-establish natural processes. However, rewilding can also determine complex management scenarios, because many expanding species can determine economic impacts and conflicts with society. Conflicts can be particularly challenging when carnivores, large herbivores, and ecosystem engineers are involved. The Eurasian beaver *Castor fiber*, a key ecosystem engineer, was once present in a large part of the Palearctic but in Medieval times it underwent a severe population decline due to the joint effects of habitat loss and hunting. Subsequently, legal protection and reintroductions triggered the recovery of the species in most of its original range. Beavers are known to modify riparian forests and river ecosystems. Here, we identified the areas where beaver populations are most likely to arrive in the next future within Europe. We developed spatially-cross-validated species distribution models to identify the areas with the highest suitability for the Eurasian beaver, potentially sustaining beaver populations. Then, we used connectivity modeling to assess the possible expansion routes of this species in Italy. We found wide areas with high environmental suitability in Europe. The connectivity model on a model country showed a high potential for expansion from most actual reproducing populations. Our results can help environmental managers to understand where to focus both future monitoring of beaver populations and actions to prevent and mitigate possible human-wildlife conflicts, which could arise from the expansion of an environmental engineer such as the Eurasian beaver.

Keywords

ecosystem engineer; habitat suitability; large rodent; riparian forests; wildlife management.

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The characteristics of the habitats associated with the riparian zone in the upper and middle basin of the Olt River and their role in ensuring the connectivity of mammal species

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Abstract

Riparian zones are considered extremely important for ensuring connectivity between spatially separated areas (Noss 1991; Ndubisi et al. 1995; Hilty and Merenlender 2004). Among all categories of small environmental elements, riparian forests provide the best conservation of connectivity (Siqueira et al. 2021).

The research area includes the upper and middle basin of the Olt River between the towns of Bălan and Râmnicu Vălcea. 50 sample areas of 500m length represented the sample from which data on habitats and signs of the presence of mammal species were collected to determine the role of riparian areas in providing local/regional connectivity. For the 50 sampled areas, a 20m strip of land on both banks was taken into analysis with the aim of limiting the data collection area and maximizing the chances of identifying the tracks crossed, which would attest to the existence of connectivity between the two river banks.

The study of habitats pointed that the proportion of forest habitats (deciduous, mixed or coniferous) is over 50%, which according to the literature is a favorable factor for the maintenance of mammal species in the riparian zone. Along with these, meadows, shrubs and agricultural lands also have an important share. The latest, even if they are anthropized habitats, are a real attraction for deer, wild boar and bear. At the opposite pole are the heavily anthropized areas that occupy less than 10% of the total.

Keywords

connectivity; habitats; riparian zones; mammal species.

The effects of riparian deforestation on riparian predatory arthropods - a case study in the catchment of the Argeș River

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Abstract

Riparian forests represent key elements that help (1) preserve aquatic and terrestrial biodiversity along flowing waters and (2) regulate ecosystem fluxes and services along riverine landscapes. Predatory arthropods constitute valuable links in the transfer of aquatic biomass into riparian forests and further along terrestrial food webs. The integrity of riparian arboreal vegetation is strongly connected to the diversity of aquatic emergent insects, of riparian predators and ultimately to the complexity of trophic webs and riverine landscape biodiversity. Our study assessed the effect that riparian deforestation has on the diversity of riparian predatory arthropods along an altitudinal and impact gradient. For this research, we selected three subcatchments within the upper Argeș catchment, where four different types of sites were sampled, based on the impact of the riparian deforestation: forested (headwater), unbuffered (midsection), buffered (midsection, after unbuffered and paired with it) and impacted (downstream, no arboreal vegetation, in agricultural landscapes). We analysed the effect of riparian deforestation on the diversity of riparian ground beetles and spiders, both structurally and functionally, monthly during their maximal activity period. Our results hint that the integrity of the riparian arboreal vegetation is beneficial for the conservation of riparian predatory arthropods and for their role of trophic linkage, even in the cases where the maintenance of vegetated buffer strips seems to be the only option available.

Keywords

riparian forest; deforestation; predatory arthropods; community structure and function; conservation.

The community structure of the millipedes from the forest sites located in the riparian areas of the Argeș River

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Abstract

Both the riparian areas and the invertebrates existing at their level are particularly important, as direct interactions between terrestrial and aquatic communities can be observed in these very heterogeneous systems that support important components of terrestrial life. The main objective of this paper is to determine the community structure of a particular taxonomic group of great importance in forests: Class Diplopoda (Subphylum Myriapoda), as they help to form and fertilize soils and increase primary production.

For this study, the millipedes were sampled from three forest sites located in the riparian areas of the middle basin of one major tributary of the Danube River: the Argeș River (south-eastern Romania). The sampling followed the CROSSLINK project methodology, taking place monthly between May and November 2018. On each site six riparian sampling plots were selected, three Barber pitfall traps being planted at three different distances from the stream. The captured millipedes were identified in the laboratory to species level and entered into a database.

A number of fourteen belonging to four orders and five families were identified, millipedes presenting high percentage abundances in all three sites.

Keywords

millipedes; riparian zones; forests; community structure.

The permeability of the upper and middle basin of the Olt River, a factor that can limit the movement of animals and its role in maintaining connectivity

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Abstract

Permeability is a term that is mainly associated with the analysis of road networks, railways or other large-scale industrial objectives that limit the crossing of areas by animals, maintaining connectivity. In a similar manner, the degree to which the Olt River can constitute a barrier to the free movement of animals was analyzed. The research area includes the upper and middle basin of the Olt River between the towns of Bălan and Râmnicu Vălcea. The criteria that have been evaluated to determine permeability are: hydrological criteria (bed width, water depth, water velocity) and geomorphological criteria (bank height, slope).

From the data analysis, the permeability is optimal and average at 57.9%, which shows quite drastic limitations, if we consider that the modelling of the routes of the potential ecological corridors took into account the identification of the most suitable crossing areas.

On the Bălan-Tușnad Băi sector, 66.8% of the sectors have average or optimal permeability. The biggest endangerment factor is the anthropogenic one, a significant part of the surfaces being grazed and fenced with electric fence. The phenomenon became more acute with the granting of aid to farmers, who accessed non-reimbursable funds that allowed them to increase the number of domestic animals and equip themselves with modern protective equipment.

Another case that has been observed is the expansion of built-up areas for tourism and relaxation. Most are fenced properties, equipped with alarm systems or guard dogs, factors that disturb the peace and reduce.

Keywords

permeability; riparian zones; connectivity; mammal species.

Session 6 Policy, science, and practice together in the field of forest on pan-European scale - ORAL PRESENTATIONS - 3rd of October 2023

KEYNOTE SPEAKER

Chairs

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Chief Executive Officer, Homo Silvestris Europae

Back to the future: 20 years of forest research and innovation - today and tomorrow!

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Abstract

Two decades of progress in forest research and innovation across Europe! How does the current impact and future potential look alike? It can be witnessed that over the past 20 years, advancements in technology, ecological understanding, and sustainable practices have helped to foster knowledge and novel practices. Delving into some pivotal breakthroughs that have shaped today's forestry landscape, the possibilities that lie ahead are based on solid grounds. The retrospective analysis highlights the evolution of forest research, tracing the journey from conventional methods to cutting-edge technologies, all stimulated by public funding programs and favoring political frameworks. During the last 20 years a new level of European collaboration in research and innovation developed and the research world will go further under a massive change in its structure and undertakings. Internet, search engines allow to find information in speed of light. The amount of information is overwhelming. Translation tools expand the accessibility to knowledge and information. Europeans live in an information society, where validation and interpretation is missing. Especially as we are facing more and more uncertainties and disruptive events. The integration of artificial intelligence (AI) will further optimize monitoring systems and support decision-making processes in forest management and planning in real-time. Innovation has not been confined to technology alone as a special emphasize was given to the role of interdisciplinary collaboration. Researchers, policymakers, and local communities have forged partnerships to address multifaceted challenges like re-/de-forestation, invasive species, habitat loss and recreation, biodiversity, soil fertility, resilience. These alliances have led to novel strategies that prioritize environmental maintenance connected to socio-economic development (reindustrialization, empowerment of rural areas, sustainable tourism, etc.). All these advancements continue to shape forest research and innovative approaches are manifold. To highlight some breakthroughs, the convergence of genomics, synthetic biology, and precision forestry offer tailored solutions for e.g., enhanced timber production, soil fertility, disease resistance, and ecosystem restoration while enhancing their resilience. The importance of sustainable practices in the face of climate change, highlighting the potential for forests to act as vital carbon sinks and contributors to climate adaptation remains to be a key thematic priority. In conclusion, "Back to the Future: 20 Years of Forest Research and Innovation - Today and Tomorrow" encapsulates the remarkable journey of forest research and innovation over the past two decades. It underscores the transformative power of collaboration and of technology while projecting a promising trajectory for the continued evolution of forestry research, innovations and practices.

Key scientific topics in the New EU Forest Strategy for 2030: A bibliometric network analysis

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Abstract

European Commission has adopted the new EU Forest Strategy for 2030 two decades after the definition of the Pan-European indicators for Sustainable Forest Management (SFM). Among the main aims of the Strategy there is the reinforcement of SFM for climate adaptation and forest resilience and the enhancement of wood-based bioenergy and long-lived wood-based products for a sustainable climate-neutral economy. These topics are also the core of ForestValue (FV), a European network of public funding organizations. The first phase of FV ran in the period 2017-2023, while ForestValue2 (FV2) started in January 2023 with the same aims: to overcome the fragmentation of public research efforts in the EU and to reinforce work on research priorities that call for a stronger coordination and collaboration. In this study, a literature review was conducted to show the main trends and knowledge gaps of scientific research on the key topics which are also covered by the next call of FV2: Resilient sustainable forest systems and management (Topic 1) and Sustainable timber building systems (Topic 2). The literature review was performed through a bibliometric network approach (Scopus database, timeframe 1992-2022, VOSviewer software). The results show more than 700 publications for each topic so distributed: EU-28 countries (61% of total publications for Topic 1 and 58% for Topic 2), USA (18% and 11%), Canada (16% and 2%), China (12% and 12%). The results show a growing trend in the last five years for both topics. The network map of the Topic 1 shows that the main clusters are related to climate storage and sequestration in forests; ecosystem services; new monitoring technologies; adaptive forest management. For the Topic 2, the main clusters are related to innovative wood-based products such as plywood and particle board, building wood materials, bio composites. The method adopted in this study will be used to evaluate the impacts of the projects carried out in the framework of FV2.

Keywords

social network analysis; bibliometric review; sustainable forest management; climate action; wood-based materials; circular bioeconomy;

Guiding principles for Romanian Forest Strategy: stakeholders perceptions

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Abstract

An important step in promoting a strategic direction to ensure a sustainable way of managing forests in Romania was the elaboration of the National Forest Strategy for 2030. This strategy contributes to the desired integration of European level objectives into national strategic plans by referring to the objectives contained in the New European Forest Strategy for 2030. The strategic options for the development of forest policies proposed in the strategy were formulated based on several guiding principles of forest management, reiterated from the perspective of validating the strategic assumptions at the European level. The guiding principles that should guide public policy in the forestry field and the main recommendations for their operationalization were subjected to a public consultation process with the stakeholders in the forestry sector. This research presents and qualitatively analyzes the opinions expressed by the participants regarding the proposed guiding principles for forest policy. The analysis is based on 146 responses received from those enrolled in the process (response rate 68%). The results showed that different degrees of consensus were highlighted during the consultation. Principles with a high consensus, reflected in firm strategic desires, and principles that create controversy among respondents, reflected in contradictory strategic options, were identified. Also, 74 responses corresponding to the formulation of new principles were recorded within the consultative process, their relevance being analyzed within this research. The guiding principles, as emerged from the opinions expressed by stakeholders, are: a) related to forest management: the principle of ensuring the continuity of ecosystem services, the principle of ensuring the stability of forest ecosystems, the principle of representativeness in biodiversity conservation, the principle of economic viability and competitiveness; b) principles of good governance: the principle of scientific substantiation, the principle of legislative coherence, the principle of administrative efficiency, the principle of respect for property, the principle of intersectoral integration, the principle of participatory politics and the principle of transparency. The importance of analyzing these principles results from the fact that they must provide the basis for the creation of a forest governance framework adapted to the structural changes of the national forestry sector.

The new European Union Deforestation Regulation: A new approach to deforestation-free products

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Abstract

In the last decades, the European Union had developed and implemented regulations and directives, aiming to fight illegal logging by promoting a sustainable management of the EU forests. Besides this in order to assure a fair trade and legal harvesting of timber that is entering EU borders, requirements like Forest Law Enforcement, Governance and Trade were set into place for non-EU countries by ratifying the Voluntary Partnership Agreements. The demand for sustainable forest management strategies, deforestation and forest degradation, protection and restoration of forests, where forests have also a key role in achieving a climate-neutral EU, triggered the development of several regulations like EU Forest Strategy, EU Action plan against Wildlife Trafficking, EU Green Deal, and EUTR. The latest regulation in this direction is EUDR (European Union Deforestation Regulation) to be set to replace the EUTR that went into power in 2013. EUDR is a groundbreaking law that sets to fight the illegal logging. Commodities were identified based on a comprehensive impact assessment as the primary drivers for deforestation, all companies that operate in the fields of palm oil, cattle, soy, coffee, cocoa, timber and rubber as well as derived products (such as beef, furniture, or chocolate) shall conduct a mandatory due diligence to prove the products are deforestation-free regardless of whether they are EU-based or not. By performing a content analysis of the documents an assessment of the current set of indicators of the new regulation in order to emphasize the effectiveness and appropriateness of them. While the main focus of EUTR is on the legality of timber, on the other side, EUDR has a wider scope and clearly points out the type of commodities and the requirements of the operators. New EUDR is setting challenging actions for those under the scope of the regulation, as a result of this the companies may use novelty tools such as satellite monitoring and isotope testing in their due diligence systems. Also, precise geolocation coordinates of the produced products are mandatory in order to guaranty the traceability requirements.

Based on the performed comparison the differences between the two regulations in regard to timber operator obligations and the responsibilities of the member states authorities when it comes up to control and sanctions were highlighted. As a novelty an on-line system will be set up to ease up the flow of information related to products placed on the EU market. Some EU countries have developed traceability systems like the case of Romania where in SUMAL 2.0 the GPS coordinates of the natural protected areas, virgin and quasi-virgin forests, harvesting plots are public.

Keywords

due diligence; transparency; deforestation-free regulation; protection;

Spatial monitoring of land use changes for effective Climate Policy Strategies: a case study of Romania's LULUCF sector

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Abstract

The national greenhouse gas (GHG) inventory, with a focus on the Land Use, Land Use Change, and Forestry (LULUCF) sector, is an essential policy instrument that integrates forests and other aspects into effective climate change mitigation commitments and adaptation strategies at both national and European Union (EU) levels. Spatial explicit monitoring has become a necessary tool to comply with new EU-UNFCCC reporting regulations and obligations, focusing on standardized methods and accurate, harmonized data required for the accounting and evaluation of changes over a long period of time. Starting from this context, the aim of this study is to evaluate the impact of public policies on land use changes by employing spatial explicit monitoring techniques in Romania over the past 30 years.

Utilizing geospatial technologies, remote sensing, and Geographic Information Systems (GIS), we analyzed and mapped land cover changes, deforestation rates, afforestation, and reforestation activities at 100x100 meters of gridded data across the entire national territory. We integrated national and global land cover and land use maps (e.g., Landsat and the Copernicus program) and used spatial autocorrelation and hotspot analysis to identify emission patterns and clusters related to land use changes. This approach allowed us to derive a spatial analysis of emission and carbon sequestration impact due to land-use management. By associating GIS analysis results with various pieces of national public policies, we quantified the impact of these policies on GHG mitigation efforts and commitments. The effects of such outcomes over the 30-year period have provided changing patterns and trends in deforestation rates at the national level. After a visible increase post-2000 years, mainly due to the forest restitution process, deforestation rates have shown a decreasing trend from the 2010-2015 period, showing the carbon net sink behavior of Romania, a fact also shown by the FAO report on the State of forest in 2020. From our results, the implementation of national public policies explained 68% of the variability of actual annual deforestation rates. Moreover, recent years have exhibited reduced emissions impact, with annual deforestation rates of approximately 2 kha/year and afforested land at 3.5 kha/year in Romania, attributing the country's LULUCF sector to the status of a sink.

The study findings highlight the necessity of spatial land monitoring approach for designing effective climate change mitigation and adaptation strategies and achieving sustainable development goals. By offering detailed and accurate data on land-use changes, policymakers can make evidence-based decisions backed by accurate and sound scientific fundamentals. The spatial data plays a critical role in identifying areas with significant emissions or carbon sequestration potential, enabling focused interventions and policy measures that encourage sustainable land use practices. Moreover, policymakers can evaluate the effectiveness of implemented policies in achieving the internationally pledged climate policy goals within the lines of emission reduction and conservation commitments regarding the LULUCF sector, giving them the appropriate incentives for future redistributive policies adapted to the society's needs and the circular bio-economy.

Keywords

LULUCF sector, spatial explicit reporting, land monitoring, quantify policy GHG impact.

Biomass In Romania for Energy and Decarbonisation: The Largest RES Available, The Least RES Used

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Abstract

Within the context of this presentation, the current situation is examined, highlighting the underutilization of biomass as a significant renewable energy source (RES) in Romania. Despite being the most abundant RES option, biomass remains largely untapped, a contrast to the extensive promotion of wind and solar energy. Interestingly, a considerable number of people depend on biomass for heating, but this isn't acknowledged as "renewable heating". Surprisingly, the energy potential in the biomass used is substantial, equivalent to the output of more than two nuclear units at the Cernavoda Power Plant. However, funding is disproportionately directed towards wind and solar projects, overlooking the efficiency improvements that biomass could provide. Intriguingly, in areas rich in biomass resources from forests and agriculture, there's a counterproductive shift towards replacing biomass with natural gas. This highlights the need for a clear and well-thought-out policy, despite the uncertainty in the EU's stance on biomass energy. Additionally, this presentation emphasizes that biomass could be a practical, cost-effective, and abundant resource for producing green hydrogen, surpassing the efficiency of using green electricity for electrolysis. In essence, this abstract sheds light on the often underestimated role of biomass in Romania's energy landscape, advocating for a strategic shift towards making the most of its potential.

Keywords

Biomass, RES, biomass use and policy, need for efficiency, confusing and neglected results.

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Abstract

The wood resource available in Romania must be used more efficiently - through industrial processing, in products with high added value, and through efficient use in energy production, according to the principle of the cascade use of woody biomass. The potential is to double the social and economic impact of the sector and to produce twice as much energy from biomass, according to the evaluations of a PricewaterhouseCoopers report, based on a studio of the "Marin Drăcea" National Forestry Research-Development Institute. According to studies, the total impact of the sector is considerable, both on the economic and social dimensions, as well as in terms of combating climate change and environmental protection. Economic activities based on the wood resource currently contribute 4.5% to GDP, or 9.86 billion Euros annually, and support more than 330,000 direct, indirect and induced jobs. At the same time, the impact of the forest-wood sector in combating climate change is annually the equivalent of more than 50 tons of CO2 retained or avoided to be emitted through substitution effects. All these benefits are extracted from a relatively small harvest of wood biomass, relative to the annual growth of forests and compared to other European countries. According to the PwC study, Romania harvests a commercial volume of 33% of the total annual growth of the forest, while the European average is around 63%, and the first three countries harvest above or close to 100%. In Romania, approximately 19 million cubic meters of wood are harvested, one third of which is used for energy production and 12 million m3 are industrially processed. The multiplier effect of wood-based industries is enormous. Each cubic meter of processed wood brings about 750 Euros in the turnover of economic operators in the sector, of which about 250 Euros reach the state budget. At the same time, every cubic meter of wood in wood products replaces plastic in packaging, iron and concrete in the construction sector, synthetic fibers in the textile industry, materials with a much larger ecological footprint. That is why the wood resource is very valuable, it must be used efficiently and intelligently. Romania's opportunity is given on the one hand by agricultural biomass and household waste, which can be successfully used for energy production and can at least partially replace wood for energy, and on the other hand by the 2 million ha of unused land. If 500,000 ha of energy crops were established from which to harvest 10 million m3 of biomass for energy production, we would release 10 million m3 of wood for industry, doubling the socio-economic contribution and environmental impact of the use of the wood resource and simultaneously providing cheap and renewable energy".

Research needs to underpin the science-policy interface related to the implementation of EU Forest Strategy: The Romanian perspective

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Abstract

The EU Forest Strategy 2021 emphasise the goal to diversify the policy instruments meant to strengthen forest protection and restoration efforts in publicly owned forests and to support private forest owners and managers with financial incentives for sustainable forest management. The transfer of this goal into national regulatory frameworks require an active involvement of the scientific communities in supporting the policy-making decision process. In Romania, the scientific community has been actively involved in taking a mediation role among stakeholders in the formulation of the national forest strategy and of the forest act. The paper presents the main direction of research that need to be strengthen in order to provide more accurate data for decision makers, to provide sound national assessments for the implementation of the best forest management practices envisaged by the EU Forest Strategy and to support communication strategies for the general public.

How traditional intrapreneurial concept can govern state-owned forest enterprise management decision toward business improvement based on forest products and services

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Abstract

The intrapreneurial concept (also known as intracorporate entrepreneurship, intrapreneurship, and corporate entrepreneurship) is a traditional perspective of forestry based on a commitment to public goods, nature and the environment, and disagreement with the concentration of wealth and power. It can be traced back to the late 19th century through Pincho's sketch as the foundation of forestry practice and forest policy. The intrapreneurial concept implies the principles of a conservation ethic, which is: "the art of producing from the forest whatever it can yield for the service of man". This concept advocates not only conservation but also the provision of public goods to society as a whole. This research aims to analyze the role of intrapreneurial concept in state-owned forest enterprises and its influence on managers' decisions on business improvement, based on forest products and services. The main research question was what conditions must be present for business improvement in state-owned forest enterprises. We used survey to collect attitudes of managers and employees from 4 state-owned forest enterprises in Serbia. The questionnaire was a combination of a research instrument for measuring intrapreneurship in large enterprises and an instrument for measuring entrepreneurship in forestry enterprises. It showed acceptable reliability. Our conceptual framework consists of following variables: demographic characteristics of employees, need for professional training, influence of business environment, flow of information, managerial support, working autonomy, reward system, working time availability and attitudes toward forest products and services. The results were used to create a model of how selected variables affect opportunities to improve business based on forest products and services. Model shows how state-owned forest enterprise managers need to decide which forest products and services are important for business improvement. Based on the team members demographic characteristics, younger employee expressed attitudes that tourism and recreational services, hunting and fishing together with non-wood forest products are potentially beneficial to the enterprise. Women have attitudes that extension service in private forests is potentially beneficial to the enterprise, as opposed to men. The model also shows specific interactions between organizational elements (variables). Management support is positively correlated with the reward system, information flow, and working autonomy, while it is negatively correlated with employees' need for professional training. The reward system and flow of information are negatively correlated, similar to influence from busies environment and working time availability. We can conclude that there are modalities between organizational elements and demographic characteristics of employees that affect the possibility for business improvement based on forest products and services. These modalities are specific for state-owned forest enterprises where employees need to fulfill public needs in which some products and services are offered for free.

Keywords

Entrepreneurship; intrapreneurship; business; forest products and services; state-owned forest enterprises; Pincho.

An in-depth analysis of state forest administration and its management tasks in Romania

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Abstract

Forestry in Romania have always been defined as a complex cumulative activity based on tradition, core fundamentals and pluralistic administration structures, playing an essential role in society with high predisposition to changes. The socio-economic perspective of forestry is closely linked to the implementation of legal framework, regardless of ownership. To this extent, state forest administration among other state forest institutions, implements the legislative framework associated with forestry and fulfill certain management tasks while only the Ministry of the Environment, Water and Forests have authority tasks. The state forests in Romania in 2021 accounts as 64.3% from the total national forest fund whereas private forests are around 35.7%, the distribution being attributed to the on-going forest restitution process. Whether or not the state forest administration successfully fulfills their management tasks in practice have been a constant debate. This research focuses on the analysis of the performance of state forest administration based on the extent of their management tasks fulfillment, in accordance to the policy goals formulated in the legislative framework or internal strategies. The performance assessment was carried out by the use of primary (semi-structure interviews and questionnaires) and secondary sources as empirical evidence serving as basis for the 3L Model methodology, which was used in this research. The 3L Model was used when applying the criteria and indicators approach for the assessment of public institutions comprehensive performance related to sustainable forest management. The results identify the differences between the status-quo and the on-field reality regarding the implementation of management tasks and forest policy goals, especially regarding cost efficiency of sustained forest stands, as the forests are sustainably managed but with high costs due to lack of forest road infrastructure for example. Moreover, the forest representation status is clearly challenged, more institutions aspire for the representation of interests in forest which leads to conflicts and questionable decision-making. Whilst the state forest administration performance is average, the state authority performance in the forestry sector is relatively low which implies that strengthening law enforcement is a must in order to mitigate illegal activities in forests and secure property rights. A shift towards activating the state forest institutions should be performed by involving all actors in the forest sector and improve the forest policy context through shared representation of the speaker/mediator role.

Keywords

Romanian forest policy, 3L Model, state forest institutions, management tasks, criteria and indictors..

Session 7 Impacts of multiple factors on forest ecosystems: risk assessment, modelling and detection methods - ORAL PRESENTATION - 3rd of October 2023

KEYNOTE SPEAKER

Remote sensing as a tool for forest monitoring and management

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Abstract

Essential variables (EV) are critical for observing and monitoring different facets of the Earth system. Many organizations including the World Meteorological Organization, the UN Environment Program, or the European Space Agency have established working groups to coordinate and identify EVs in fields such as oceanography, climatology, biodiversity, or geodiversity. EVs related to vegetation characteristics and dynamics are the object of various groups including the Global Climate Observing System (GCOS) and the Group on Earth Observation (GEO) Biodiversity Observation Network (BON). This presentation focuses on the increasing role Earth Observation (EO) plays in the characterization and monitoring of forest-related EVs which lie at the intersection of GCOS and GEO BON working groups and affect earth-atmosphere fluxes and biodiversity. EO technologies (e.g., sensors, techniques, approaches) and their latest trends are also discussed.

Exploring non-linearity in Norway Spruce dendroclimatic models in Eastern Carpathians (Romania)

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Abstract

Decrypting and understanding tree growth response to climate is still a central challenge in tree ring science. Various statistical methods were applied, from linear correlation to machine learning techniques, from frequentist to bayesian approaches or process-based models. The study aimed to evaluate the relationship between tree ring index and seasonal climate parameters (temperature, precipitation and SPEI) using machine learning techniques (Random Forest Analysis - RFA). The dataset consists of a large tree-ring network of 156 Norway spruce chronologies (2994 trees), from managed stands, covering different age classes and distributed along an altitudinal gradient in Eastern Carpathians (Romania). Daily climate data from E-OBS grid data downscale to a high-resolution grid (1 km2) (Moreno and Hasenauer (2016) were aggregated on a seasonal time scale. Raw tree ring widths were detrended using a 30-year cubic spline with a 50% frequency cut-off. Based on Random Forest analysis, the most important climate variables on Norway spruce radial growth were the drought intensity from the previous autumn and summer. The winter temperature had high relative importance as well (RFA). The differences in growth-climate responses within the altitudinal classes were highlighted. Partial dependence plots from RFA indicate a non-linear relationship between spruce growth and previous autumn temperature as well as the SPEI and the previous summer SPEI. We can observe a non-linear relationship between growth and previous autumn temperature with previous summer precipitation, respectively. Our preliminary results show that the relationship between Norway Spruce radial growth and climate, in the Eastern Carpathians, is complex and requires future investigations.

Keywords

tree ring; dendroclimatology; Picea Abies; climate change; drought

Tree height, crown and slenderness ratio mixed-effects seemingly unrelated models for the Transylvanian region

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Abstract

Tree height is commonly predicted for all trees to estimate stand volume before harvesting, which is mandatory in Romania and serves as the standard for estimating the harvested stand volume. However, a sample of heights must be measured for each harvested stand and a local height-diameter model is developed, which can be a laborious process. Tree crown and slenderness ratio are commonly used variables in individual tree growth models, and their values are strongly related to tree height. The objective of this study is to develop height-diameter, and crown and slenderness ratio models that are applicable to the Transylvania region. The study was conducted from 2020 to 2022, measuring over 24,000 trees on a systematic grid of plots covering the southern part of Transylvania region, Romania. Height-diameter relationships, crown ratio model, and slenderness model were developed for the most important species. The functions used were chosen based on the cross-correlation power of their coefficients. The models were fitted simultaneously using mixed-effects seemingly unrelated regression, taking into account the hierarchical structure of the data. The developed models include both stand and tree-level variables that consider competition and can be utilized practically by forestry practitioners and growth modellers. One significant advantage is the ability to cross-calibrate the random effect in case of new observations, reducing fieldwork time and simplifying the calibration of an entire growth model with only a few tree heights needed. The study demonstrate the advantages of using mixed effects seemingly unrelated framework through cross-model calibration of one of the functions when new observations become available.

Keywords

mixed effects; seemingly unrelated regression; best linear unbiased predictor; simultaneous fitting

Spatial Root Distribution: A Meta-Analysis

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Abstract

Root distribution plays a crucial role in understanding plant resource acquisition and ecosystem functioning. Spatial analysis of root distribution provides valuable insights into the allocation and utilisation of belowground resources. This study presents a comprehensive meta-analysis that synthesises the available literature on root distribution across diverse ecosystems. The aim is to provide a comprehensive understanding of the factors influencing root distribution patterns and their spatial variability. The meta-analysis includes a systematic review of 61 scientific literatures published during 1991-2019 for woody species considering various soil types, taxonomic classes, plant age and experiment type. A robust database comprising root distribution data from multiple plant species and ecosystems was constructed. The spatial analysis focused on examining the key drivers of root distribution patterns such as root: diameter, length, mass, density, numbers and tips. Various factors, including soil properties, climate (e.g., temperature, precipitation), vegetation characteristics (e.g., species, age), and land use (e.g., forest, orchard), were investigated. The meta-analysis revealed significant spatial variability in root distribution patterns across different land use. It was found that soil properties, particularly texture and land use, exerted strong control on root distribution. Climate variables, such as temperature and precipitation, also exhibited notable effects on root distribution patterns. Moreover, vegetation characteristics, such as plant functional traits, influenced root distribution to varying extents. The findings highlight the importance of considering spatial heterogeneity when studying root distribution. The results have implications for ecosystem management, crop production, and restoration practises, emphasising the need for incorporating root distribution data into predictive models and decision-making processes. In addition, according to the meta-analysis, we will also discuss an implication about an accessibility of soil water in trees from various depths of soils.

Keywords

soil; depth; water; root profile; review.

Deriving annual forest biophysical variables by combining Airborne Laser scanning with active and passive satellite sensors

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Abstract

Comprehending forest dynamics is one of the main goals of forest management. Remote sensing data has been a crucial tool in the observation of forests in recent years. Given the high temporal and spatial resolution, as well as free access policies, a range of possibilities has been opened to understand forest growth patterns and monitor its dynamics. In this study, we analyze different combinations of active and passive satellite sensors to estimate yearly forest biophysical variables (i.e., canopy height -CH, forest canopy cover -FCC, and above-ground biomass -AGB) derived from quinquennial airborne Light Detection And Ranging (LiDAR). A series of Random Forest (RF) regression models were calibrated to analyze the sensor combination that provides the most efficient retrieval over two study areas located in Spain: 1) the Community of Madrid (CAM), characterized by a Mediterranean-Continental climate and, 2) the Basque Country (BC), characterized by an Oceanic climate. Passive (i.e., Landsat 7/8 and Sentinel-2 A/B), and active sensors (i.e., Sentinel-1 and PALSAR-2) were used to reduce limitations due to consistent cloud cover over some regions. Results show that, overall, most combinations perform well in semi-arid forests (CAM), with an R2 ranging from 0.77 to 0.81 for CH; from 0.73 to 0.80 for FCC; and 0.75 to 0.77 for AGB. Models that include Sentinel-2 data in combination with another sensor (i.e., Landsat), show the lowest errors with a RMSE of 1.69 (m), 14.12 (%) and 28.59 (t/ha) (CH, FCC and AGB). In higher biomass atlantic forests (BC) no model provided satisfactory results. The most accurate results were obtained for the model that combines Sentine-2 and Sentinel-1 data with an R2 of 0.60 (CH), 0.61 (FCC) and 0.53 (AGB). Overall, more accurate estimations were observed in forest areas less affected by clouds (i.e., increased optical observations).

Keywords

Height; Canopy cover; Biomass; LiDAR; Estimation; Random Forest (RF).

The use of biophysical indices, derived from Sentinel 2 satellite images, to assess defoliating insect damage

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Abstract

Defoliation monitoring and assessment is an important forest protection activity, where satellite remote sensing has special interest practical applications. Based on the Sentinel 2 satellite images, were determined the main biophysical indices (LAI, FAPAR, FVC, CAB, CWC), which are sensitive to the chlorophyll content and provide an insight into the physiological processes of defoliated trees with different intensities. Through simple regression analysis, was established the correlation between the pixel values of each biophysical index and the real defoliation evaluated in the field, for samples area sampled in the years 2020 and 2021. Thematic maps regarding the results of defoliation evaluations obtained from the ground and thematic maps obtained on biophysical indices determined on intervals of variation of pixel values, specific to each degree of defoliation and statistically proven to be significant, allowed the calculation and comparison of damaged surfaces, on degrees of defoliation.

Keywords

Sentinel 2; biophysical indices; defoliation; thematic map; monitoring; assessment.

Predicting tree crown width of individual trees in the Western Southern Carpathians using terrestrial laser scanning and Random Forest algorithm

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Abstract

Crown width (CW) and its projection (CPA), along with diameter at breast height and total height of trees, are two highly important attributes in assessing forest resources and ensuring sustainable management. This study focuses on a mixed forest area located in the western part of the Southern Carpathians, Romania. Reference data were collected with high precision through field measurements. This study aims to investigate the use of data obtained from Terrestrial Laser Scanning (TLS) in predicting the crown width of segmented trees and evaluating the contribution of variables used in CW prediction through the Random Forest algorithm. The process of segmenting trees from TLS data involved identifying the position and biometric characteristics (e.g. diameter at breast height, height, crown width). The model employed in this study successfully predicted crown widths (CW), explaining approximately 67% of their variation. This is supported by the values obtained for the Mean Absolute Error (MAE) of 0.82 m, Mean Squared Error (MSE) of 1.05, and Mean Absolute Percentage Error (MAPE) of 16.30%. Analyzing the contribution of variables used in CW prediction, it was found that variables such as basal area (BA), Simpson index of diameter classes (SI), and McIntosh uniformity index of diameter classes (MI) had the greatest impact, contributing around 16% to the precision of CW prediction. On the other hand, variables such as tree height diversity (THD), height differentiation index (TH), and additive stand density index (aSDI) had a smaller contribution of approximately 7% in improving the precision of CW prediction.These results highlight the potential of TLS technology used together with the Random Forest algorithm for predicting CW and assessing forest resources. By gaining a deeper understanding of the contribution of different variables and how they influence the size of the crown, more informed decisions can be made in forest management and conservation.

Keywords

Random Forest algorithm; tree crown width; terrestrial laser scanning (TLS); crown width; segmentation of individual trees.

Tracking historical land cover changes in the Peruvian Amazon using Landsat, Sentinel-1 and temporal segmentation

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Abstract

The IPCC recognizes land use and land cover change as one of the main drivers of climate change. In this context, forests play an essential role in carbon sequestration and storage. Thus, is essential to monitor forest losses, and what happens afterwards: are trees allowed to regrow? The land is used for crops or raising cattle? This information matters when designing policies aimed to curb deforestation. Remote sensing represents a very powerful tool for this task, as it can retrieve systematic data over very large areas. Note these techniques are not without limitations, such as cloud cover, and classifier instability. In this study we used the continuous change detection and classification algorithm (CCDC) over Landsat and Sentinel-1 data to map historical land cover and land use changes across 243,864 km^2 of the Peruvian Amazon. CCDC was chosen because it is resistant to cloud cover, and involves both temporal segmentation and modelling, describing yearly cycles without neglecting the possibility of change. Classification was based on harmonic regression parameters, very powerful features to separate land covers that may be similar during part of the yearly cycle (e.g., as bare ground, post-harvest crops). Results using Landsat bands had an overall accuracy of 73%, whereas combined classifications where Sentinel-1 polarizations were added attained an accuracy of 77%, showing promise as a tool for tracking land cover dynamics over cloudy areas such as the Amazonian rainforest.

Keywords

land cover changes; Landsat, Sentinel-1; temporal segmentation.

Urban trees detection using very high-resolution satellite imagery - smart solution for municipal green cadaster

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Abstract

The need to monitor and conserve green spaces in urban environments is increasingly recognised, in a context in which remote sensing techniques play an important role in analysing vegetation cover, identifying tree species, and assessing their biometric characteristics. Using very high spatial resolution imagery for identifying tree species within urban areas offers significant advantages, particularly in terms of i) detecting plant species in residential areas and ii) reducing the time required for field campaigns. The objective of this study is to explore the potential of very high-resolution imagery for detecting tree species within urban areas, providing a smart and alternative solution for the realisation, or updating the municipal green cadaster. The methodology uses Pleiades very high-resolution imagery together with an object-based image classification and machine learning algorithms (i.e., Random Forest). The study focuses on a specific area in Romania, Iași County. An important step in the identification of tree species process is distinguishing tree-covered areas from grassy or lawn areas. In this aspect, several approaches have been used, including the use of spectral indices derived from the Pleaides imagery and information related to forest height provided by the global forest canopy height map. Preliminary results of the study showed that the most suitable variables used for object-oriented classification of satellite Pleiades images are all spectral bands of the sensor, along with select Haralick texture features such as energy, entropy, and correlation. The Random Forest algorithm applied for the two predominant tree species (*Robinia pseudoaccacia L.* and *Tilia cordata Mill.*) of Iași showed an overall accuracy of prediction of over 70% for both tree species. Moreover, the classification algorithm successfully identified tree species in other areas within the municipality where no inventory had been conducted previously. These findings improve the efficiency and accuracy of urban tree species detection, contributing to better management and planning of green spaces in municipalities.

Keywords

Urban tree detection; random forest classifier; object based classification; Pleiades imagery.

Exploring the correlation between Above-Ground Biomass and Multispectral Sensor Data Collected from UAVs in mature Sessile Oak Forest Stands

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Abstract

The increasing concentration of greenhouse gases (GHGs) in the atmosphere, which negatively affects the global climate system, is considered a significant risk to the natural balance of ecosystems. To mitigate the adverse effects of climate change, forests are being recognised as a sustainable solution that can help reduce CO_2 emissions and enhance carbon sinks, especially in tree biomass pools. However, estimating the carbon balance by traditional methods, such as inventory plots, requires intensive field inventory and data analysis, and can be costly and time-intensive. Remote sensing techniques have emerged as an efficient and economical way to monitor above-ground biomass. Typically, biomass estimation from UAV (Unmanned Aerial Vehicle) focuses on determining correlations between crown characteristic metrics from aerial images and tree biometric characteristics such as height and diameter at breast height (dbh), as well as forest stand characteristics such as the number of trees per area, which can result in overall high estimation uncertainty.

This study proposes to explore the relationship between above-ground biomass (AGB) of tree groups and canopy structural parameters, as well as vegetation indices, to develop gridded products for AGB estimation of overstory. The study focuses on three types of Sessile Oak forests, which differ in terms of crown cover, average dbh and average tree height characteristics. The sites are located near the Brasov area region, at a distance ranging from two to twenty kilometres. These are even-aged mature stands with an area varying from 2-3 hectares each (total study area of 8 hectares), and with specific variations in mean stand dbh from 50 cm to 70 cm, mean stand tree height from 23 meters to 27 meters, and crown cover between 30% and 80%.

For each forest location, we measured the biometric characteristics of all trees (a total of 345 individual trees), such as dbh, height to compute AGB based on national and species specific allometric equation, and precise tree coordinates, as well as topographic measurements of the land model. At the same time, high-resolution images were collected from the study site using a precision RTK UAV equipped with a multispectral sensor, for which the same flight parameters were applied to obtain a consistent ground sample distance (GSD) of 10 cm/px for each location. A crown height model (CHM) was produced using a digital surface model (DSM) obtained from the collected UAV images and a digital terrain model (DTM) obtained from ground point measurements. Additionally, vegetation indices (VIs) were

estimated based on the information collected from the multispectral bands. Furthermore, the individual trees were clustered into 113 groups using automated and manual tools based on the CHM. The research objectives were to (1) identify the relationship between above-ground biomass (AGB) and canopy structural parameters, as well as (2) between AGB and VIs, and (3) develop a gridded AGB product based on these relationships to evaluate stand carbon stock and carbon stock changes in Sessile Oak mature stands.
To understand the relationships between pixel statistics of the CHM and trees AGB, the canopy structural parameters, such as canopy area, maximum canopy height, mean canopy height, standard deviation of canopy height, and canopy volume, were compared. The results indicate a strong positive correlation (r2 = 0.91) between tree groups AGB and canopy volume computed from CHM and GSD information. In the same manner the study of the relation between AGB and NDVI revealed also a strong correlation (r2 = 0.79). Linear regression analysis was performed to predict AGB values at the pixel level for each tree group. The model was tested by randomly dividing the data into training and testing datasets to further investigate this relationship. The performance of the regression model evaluation showed an average RMSE error of 1.95 t d.m. and a coefficient of determination (R2) of 0.91 for tree group AGB estimation, indicating that the model performed well in predicting AGB for the test data. The area specific AGB measured for all three stands was 126.08 t d.m. ha-1 (or 64.3 t C ha-1 referred to the C stock), compared to the model predicted gridded data result in a small underestimation of area specific C stock of -3.50 t C ha-1.
Our study provides new insights into the potential of remote sensing techniques to estimate above-ground biomass, which can help improve our understanding of forest carbon stocks and contribute to developing more effective forest management strategies.

Keywords
Crown height model (CHM); NDVI; above ground biomass (AGB); unmanned aerial vehicle (UAV).

The Spanish atlas of forest disturbance

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Abstract

Forests are a key element for carbon sequestration and a major component of rural development providing habitat, protective functions, as well as contributing with goods and services. Biotic and abiotic disturbances are natural processes driving forest dynamics. However, many forest ecosystems have experienced increased disturbance rates with recent trends reaching an unprecedented level. In Europe alone, 17% of forests were affected by some type of disturbance over the past 20 years. Similar tendencies have been observed over the peninsular Spain where large forest areas are affected by fires every year while smaller areas are affected by insect outbreaks and pathogens. Such disturbances may be identified and monitored by means of remote sensing including from historic archives such as those used to derive the Spanish Atlas of Forest Disturbance (SAFoD). SAFoD uses the entire Landsat archive to generate a comprehensive database of disturbance events (1985-2022) as well as the major agents driving them. SAFoD combines the latest advances in remote sensing for forest monitoring including the Continuous Change Detection and Classification algorithm in conjunction with Spectral Mixture Analysis and the Continuous Degradation Detection algorithms to provide, among other, information on disturbance year and month, its magnitude as well as its probability [1]. Using time series of Landsat images, the algorithm measures the proportion of different types of cover within a single pixel and detects those significant spectral responses on the earth's surface, which makes it possible to locate changes in forest cover.

This contribution presents the methodological developments behind SAFoD, the cartographic results over the entire Iberian Peninsula, as well as the preliminary validation of this database which reaches accuracies between 80 and 95% depending on the reference data used.

Keywords

forest disturbance; Landsat; temporal analysis.

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No evidence that coring affects tree growth or mortality in three common European temperate forest tree species

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Abstract

Tree cores are a highly valuable scientific method and resource. Annual growth ring data can, for example, improve our understanding of climate change impacts and detect effects of environmental pollution, allow for better annual estimations and modelling of tree growth patterns and carbon storage, and help quantify dynamics and changes in forest ecosystems. The value of coring trees for research has been weighted against concerns around the potential harm coring might cause to trees. To date, there is limited research accurately quantifying the potential effects of coring on tree growth and only a handful of studies assessing its influence on mortality. Consequently, many European long-term forest inventorying and monitoring programs are concerned that tree coring might bias the repeated tree measurements in permanent plots, which they rely on for assessments of states and changes of forests. Tree coring is additionally debated in the context of protected forests as it raises ethical questions for conservation, and in an economical context as forest practitioners are concerned about wood quality. In this study, we assessed the effects of tree coring on the growth and mortality of three widespread European tree species approximately 10 years after they were cored. We used repeated tree measurements from permanent research sites in Switzerland and Ukraine. In Switzerland, we assessed 35 cored and 159 uncored Norway spruce (*Picea abies*) trees as well as 147 cored and 332 uncored silver fir (*Abies alba*) trees. In Ukraine, we assessed 348 cored and 6’611 uncored European beech (*Fagus sylvatica*) trees. We found no statistical evidence that coring negatively affected the growth or mortality of the three tree species assessed. Although we cannot rule out subtle effects on tree health and wood quality, our findings do not provide any evidence that coring affects or biases repeated measurements (such as DBH measures and recording of mortality) performed on the investigated tree species. Tree coring could therefore be considered more often for routine incorporation, particularly in long-term forest inventorying and monitoring programs and initiatives and would be beneficial to improve detection of change and models in the future.

Keywords

forest ecosystems; forest monitoring; national forest inventories; growth detection methods; modelling.

Modeling and prediction of forest soil properties in the Czech Republic as a basis for sustainable forest management

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Abstract

Forest soils in the Czech Republic were significantly impacted by acid deposition in the second half of the 20th century. High amounts of sulphur and nitrogen compounds have been deposited in the soils and led to a decrease of soil pH and base saturation, and loss of base cations (particularly Ca and Mg), especially in the mountainous regions. To describe the current situation, we compiled a large national forest soil property database combining harmonized results from several surveys from the period 2000-2020.

After testing different methods for soil chemistry prediction (MARS, SVM, RF) the models based on Random Forests were selected as the best procedure due to the capability of working with wide spectrum of categorical variables – including those with large number of individual categories as „soil type" or „natural forest area". Using new sets of models new maps of soil carbon concentration and stock were processed for upper organic layer as well as for mineral layer up to depth of 30 cm. Other modelled and mapped parameters were stock of main nutrients (P, K, Ca, Mg) in upper organic layer, their concentration as well as soil reaction pH(H2O), pH(KCl), and base saturation in the upper mineral layer (0-30 cm). Concentration of base cations (Ca, K, Mg), pH and base saturation were used also for defining forest categories with different risk of soil acidification: slightly-, moderately-, strongly-, and extremely endangered.

We found that most forests in the Czech Republic have very acidic soils, with very low base saturation. The maps created using the digital soil mapping approaches show that soil are acidified not only in the mountains, but also in middle and lower altitudes where the acidification impact was considered small. Worse situation is naturally under coniferous forests.

Another aim was to describe the temporal development of soil properties over the last 20 years. It was found that most nutrients (particularly available P) and base cations (Ca, Mg) have an insignificant, but clear decreasing trend both in the forest floor and in the mineral topsoil (0-30 cm).

New project aimed on consequences of forest management procedures for soil carbon stock has been started in April 2023. Main goals of this project are: i) to elaborate up-to-date inventory of carbon in forest soils for the soil organic layer (FH), upper mineral layer (0-30 cm) and deeper mineral layers (30-80/100cm); ii) to update maps of carbon stock in forest soils of the Czech Republic; iii) to define effect of different forest management options on soil carbon stock and to draw up practical guidelines to support selected mitigation measures.

Keywords

forest soil; modelling; chemistry prediction; acidification; base saturation; carbon stock; temporal changes.

UAV applications to assess short-term dynamics of slow-moving landslides under dense forest cover

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Abstract

The paper presents a methodology to rapidly assess and map the landslide kinematics in areas with dense vegetation cover. The method uses aerial imagery collected with UAVs (Unmanned Aerial Vehicles) and their derived products obtained from the structure from motion technique. The landslide analysed in the current paper occurred in the spring of 2021 and is located in Livadea village from Curvature Subcarpathians, Romania. This landslide affected the houses in the vicinity, and people were relocated because of the risk of landslide reactivation. To mitigate the landslide consequences, a preliminary investigation based on UAV imagery and geological-geomorphological field surveys was carried out to map the active parts of the landslide and establish evacuation measures. Three UAV flights were performed between 6 May and 10 June using DJI Phantom 4 and Phantom 4 RTK UAVs (Real-Time Kinematic Unmanned Aerial Vehicles). Because it is a densely forested area, semi-automated analyses of the landslide kinematics and change detection analysis were not possible. Instead, the landslide displacement rates and the changes in terrain morphology were assessed by manually interpolating the landmarks, mostly tilted trees, collected from all three UAV flights. The results showed an average displacement of approximately 20 m across the landslides, with maximum values reaching 45 m in the transport area and minimum values below 1 m in the toe area. This approach proved quick and efficient for rapid landslide investigations in a densely forested area when fast response and measures are necessary to reduce the landslide consequences.

Phenological Stages Assessment Using Terrestrial Laser Scanning: Analyzing Point Density And Reflectance Intensity

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Abstract

The overarching goal of the research presented in this paper is to evaluate the potential application of active sensor-based remote sensing techniques in the monitoring of forest ecosystems.

In this specific investigation, field measurements were undertaken within a mixed forest stand consisting of *Carpinus betulus*, *Acer campestre*, *Tilia cordata*, and *Quercus robur*. The primary objective was to gain a more precise understanding of the early stages of vegetation growth, particularly in the context of reduced precipitation.

The study primarily focuses on analyzing phenological processes at an enhanced spatial resolution. This was accomplished by employing terrestrial laser scanner data and constant reflectance panels to study specific horizontal layers within the forest. Scanning activities were conducted daily from March 2023 onward, taking into consideration the sensor's position and the time of day. The scanning density was set at 3 points per millimeter at a distance of 10 meters from the scanner, allowing for the detailed capture of individual trees from each species. Supervised thresholds were established for each tree to delineate their main components. Various metrics, including coverage, density, Gap Fraction, and Leaf Area Density (LAD) indices, were computed. Additionally, the study involved an analysis of the changes in intensity values recorded for each species. Ground truthing was performed using photography following the guidelines outlined in the ICP Forests manual.

The preliminary results reveal a sequential progression in the monitored forest ecosystem. For instance, the hornbeam consistently exhibited a daily increase in LAD across all layers until the development of epicormic branches began to cast shadows on the upper canopy, diminishing visibility. Interestingly, despite the anticipated similarity in phenological development based on previous years' observations, the small-leaved lime showed a delay of 16 days compared to the oak. By that point, the oak had already progressed through four stages of bud flushing (18-20-23%), while Tilia cordata was still in the monitoring phase.

Keywords

phenology; TLS; reflectance; LAD.

Shifting vegetation phenology in Protected Areas: A Response to Climate Change

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Abstract

The current research delves into the correlation between phenological phases in protected natural areas and the effects of climate change. Our investigation, which combines the analysis of remote sensing data with observed climatic information and climate projections, reveals a substantial rise in vegetation biomass, as indicated by various factors such as Leaf Area Index (LAI), Normalized Difference Vegetation Index (NDVI), climatic growing degree days (GDD), and the duration of the climatic growing season (GSL) within protected areas in Romania.

All the assessed phenological indicators, including the start (SOS) and end (EOS) of the vegetation growth season, the moment of peak vegetation growth (POP), and the length of the vegetation season (LOS), have exhibited significant alterations between 2001 and 2020. In many instances, there is a consistent trend toward earlier occurrences of peak vegetation growth and the end of the vegetation growth season, particularly in forested areas and grasslands located in protected regions in the southern and southeastern parts of Romania.

Additionally, there has been an elevation-related shift in bioclimatic indicators, with parameters expanding from lower, southern regions towards higher elevations in the Carpathian Mountains. Consequently, from 1961 to 2020, areas with cumulative temperatures exceeding 3000°C during the vegetation growth season have expanded, while areas with cumulative temperatures lower than 1500°C during this season have decreased.

Climate projections for the periods 2041-2060 and 2081-2100, based on the RCP 8.5 scenario (a pessimistic climate scenario), indicate that extensive portions of protected areas will encounter exceptionally high Growing Degree Day (GDD) values. Regions most exposed to these elevated temperatures, exceeding 3000°C during the vegetation season, are projected to encompass 34,244 km2 (61.7% of Romania's total protected area) under the RCP 4.5 scenario (an optimistic scenario) and 48,797 km2 (87.9%) under the RCP 8.5 scenario. These findings underscore the substantial impact on the resilience of ecosystems within protected areas.

Understanding the timing and dynamics of the vegetation season holds paramount importance on a global scale. It serves as a critical tool for monitoring ecosystem well-being and gaining deeper insights into the repercussions of climate change on biodiversity. By examining the vegetation season, researchers can evaluate how plant communities respond to shifting environmental conditions, detect changes in phenology, and assess the overall health and adaptability of ecosystems. This knowledge is indispensable for effective conservation strategies, land management practices, and policy decisions aimed at mitigating the consequences of climate change on biodiversity worldwide.

Keywords

phenological phases, bioclimatic indicators, climate change, protected areas.

Diversity of spatial structure and structural indices in mixed Norway spruce (*Picea abies* L.) silver fir (*Abies alba* Mill.) and beech (*Fagus sylvatica* L.) stands from the north of the Eastern Carpathians

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Abstract

The information about the structure is what gives the first image on the trees, based on data that is currently collected in forest inventories. Analysis of different characteristics of the forest structure - distribution of tree attributes, spatial distribution of tree species and their size, crown length and foliar area are also the basis for analysis for forest disturbances, including forest exploitation [1]. The research material consisted of three representative permanent experimental plots installed in mixed stands with Norway spruce, silver fir and beech from the north of the Eastern Carpathians. Research aspects related to the homogeneity of the stands, the horizontal spatial model, the vertical model, the distribution of stands dimensional parameters the degree of heterogeneity expressed by the Gini index were studied. The value of tree height diversity index (THD) varies between 2.74 and 2.93. In Norway spruce, silver fir and beech mixed stands, beech displayed the high degree of structural heterogeneity of stands in which the proportion of species is approximately equal to the obvious homogeneity of the structure of the stands in which Norway spruce is the dominant species. If the values of the Gini homogeneity index are analyzed for the component species of stands, Norway spruce is found to be the species with the highest homogeneity (H - 5.85 within the stands; 7.63; 4.75), while the silver fir (H - 2.38; 2.13; 3.02) and the beech (H - 2.32; 2.13; 3.57) is characterized by an accentuated heterogeneity. The results obtained showed that mixed Norway spruce, silver fir and European beech stands can develop in a fundamentally different way. As a result, group or mixed groups of trees lead to a more uniform increase in all tree species, as intraspecific competition takes place in a small space and therefore, tends to materialize a mixture of species with beneficial consequences on the development of the whole forest.

Keywords

mixed stands; forest structure; Norway spruce; silver fir; European beech.

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Managing natural regenerations after clear-cuts in hybrid poplar (*Populus x canadensis*) plantations in the Lower Danube

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Abstract

The lower course of the Danube is one of the most important wet ecoregions of the temperate zone in the northern hemisphere. Due to their rapid growth, poplars and willows, are some of the most widespread forest species in the world, essential for current and prospective societal needs regarding renewable energy. However, biodiversity has to be preserved in the natural forests of the Danube islands and floodplains, whereas hybrid poplar and willow crops, cannot ensure the biological stability of these ecosystems. The negative effects of climate change, especially felt in southern Romania, were amplified by the consequences of previous anthropogenic interventions, namely river flow regulation by the embankment on large stretches of the Danube River, resulting in a decrease in the level of phreatic waters that in turn contributed to a decrease in productivity of *Populus x canadensis* plantations. The fluctuation of the Danube's waters over the past decades, and in particular the periodic prolonged flooding, caused difficulties in the normal operation of the silvicultural works in hybrid poplar plantations (e.g. harvesting, regeneration, tending operations), resulting in the natural regeneration of these stands on significant areas along the Danube floodplain. Through this article, the authors bring forward plausible management solutions for the natural regeneration that occurred in hybrid poplar stands that were harvested and not reforested, taking into account the economic and ecological aspects involved.

Keywords

flood plain; hybrid poplars; natural regeneration; management.

Soil damage and its tolerability thresholds after timber harvesting – a case study from southwest Romania

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Abstract

This study analyses the damage of soil on skid trails after timber harvesting works, performed in 24 logging sites in southwest Romania. Research purpose was to establish soil tolerability thresholds on skid trails, within whose limits, soil damages are recovering in a short period of time, reducing the possibility of their evolution towards soil degradation through the flow of water and the formation of rainfall flows on skid trails. Field observations began in 2019 and were resumed yearly until 2022. The restored damages of soil were analyzed in regard to damage type, width and depth and skid trail slope. The damages found were annually classified into restored damages, regressed damages, static damages and progressing damages. On logging sites from hill and mountain area, establishing soil tolerability threshold on skid trails after timber harvesting have been done based on the type of damage and the slope of skid trail. The differences regarding the skid trail slope between damages category above mentioned were highlighted using t-student statistical test. In logging sites from plains, where the relief energy is reduced, establishing of soil tolerability threshold was done based on the average depth of the damage, the differences between the average depth being highlighted between the mentioned damage categories using t-student test. In the hill and mountain area, the tolerability threshold of soil on skid trails, after timber harvesting is influenced by the slope of the land, as follows: below 15% slope, the soil is restored, 15-17% slope - the damage enter into a restoration process in a short period of time, 17-20% slope - the damage remains static for a long period of time, over 20% slope - irreversible soil degradation occurs. In the plain area, the tolerability threshold of soil is influenced by the depth of the injury as follows: up to 8 cm, the injuries are restored or regressed in a very short time, and up to 9 cm deep, they remain static after the passage of three vegetation seasons from their observation.

Keywords

logging technologies soil degradations silvicultural works logging yards skid trails

Short-term effect of silvicultural interventions on stand traits, soil microenvironmental conditions and ground vegetation diversity in a former virgin mixed forest

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Abstract

In the context of climate change, an increase of the disturbance events on forests has been recorded in the last decades, with implications for carbon storage and other ecosystem services. While the natural disturbance regime of undisturbed forests by humans (i.e., virgin forest) has been studied in the past, little is known about the impact of first silvicultural intervention on a former virgin forest, at least in Europe. We investigated the short-term effects of first silvicultural intervention (i.e., group shelterwood system) on (i) different stand structural characteristics (tree density, species composition, basal area, volume), amount of deadwood and natural regeneration, (ii) on light conditions and ground vegetation diversity and (iii) on soil respiration and soil microclimate. The study was carried out in a former virgin forest (FVF) situated in the immediate vicinity of the Sinca virgin forest (VF), in the northern part of the Fagaras Mountains (Romania). Experimental design was conducted in quadratic sample plots (50x50m), randomly distributed in the two forests, ten plots in VF and eight plots in FVF. Eight years after the first silvicultural intervention, the mean density of living trees was greater in the VF (650 ±46.2) than in the FVF (507±53.0), but without significant difference ($p>0.05$). Besides, significant differences were found by other biometrical parameters such as stand basal area and volume, which was significantly lower in the FVF. The amount of the total deadwood (DW) in the FVF was approximately half (46%) comparative with the VF (112 m^3 ha^{-1} vs 244 m^3 ha^{-1}). Furthermore, the average dead-to-live wood ratio was slightly higher in VF (21%) than in FVF (18%). Additionally, the deadwood structure on decay class was almost similar between both sites, with 70% and 60% respectively of the DW amount, recorded in the most advanced decay classes. The regeneration density per hectare was almost similar between the two forests, slightly higher in FVF (6744 seedlings) than in VF (6015 seedlings). Species composition of the regeneration was similar, with the most common species being European beech for both forests, but with a higher proportion of silver fir in FVF (16%), than in VF (5%). As expected, the light conditions were significantly better in the former virgin forest. Even though silvicultural interventions started less than ten years ago, it was still observed that adventive geo elements (e.g., Festuca drymea, Erigeron annuus, Erectites hieracifolia) appeared in the FVF, unlike in the VF. Our study revealed the importance of silvicultural interventions effects on forest characteristics, especially the differences in soil microclimate and the proportion of regenerated species between both forests, with possible consequences on natural forest type. To promote the regeneration and recruitment of silver fir, which according to prior studies will disappear in many European old growth forests, will be a challenge for foresters to take beneficial and rapid measures to preserve natural species composition over time.

Keywords

former virgin forest; structure; regeneration; deadwood; soil respiration; ground vegetation diversity

The introduction of forest species within an agricultural farm and its transformation into an agroforestry system – case study

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Abstract

Romania's agricultural area is 14.6 ha (61.3% of the country's total area), large areas occupying the arable land and pastures. The arable land occupies 9.4 ha and is concentrated in the area of plains and low hills, in the west, south and east of the country. This also represents the most exposed area from a climatic point of view and with the lowest percentage of forest vegetation cover. Some farmers have become aware that they can protect their agricultural crops and increase their agricultural production with the help of forest vegetation, thus establishing the forest shelterbelts.

A particular case is represented by an agricultural farm - Rogadria Ogoru Farm, in the south of the country, of 55 ha, where trees and shrubs were planted following an alley cropping, hedgerows and groups in order to improve microclimatic conditions.The farm is located in Bărăganului Plain, a silvosteppe plain, characterized by high temperatures in summer and an annual average temperature of 10.60 C, little precipitation (476 mm), cold winds in winter and dry winds in summer. The prevailing winds from the north-east in winter and the south-west in summer have a negative influence on agricultural vegetation, the winter ones, cold and with high speeds, shattering the snow, and the dry and hot summer ones reducing air and soil humidity and increasing evapotranspiration. The soil type identified is chernozem, limestone subtype. The main activity of the farm is agricultural production (corn, wheat), but on smaller areas a cherry orchard was established and two greenhouses were built for the production of strawberries, raspberries, blackberries, respectively a small factory for the production of juices and ice-cream. In the farm, in a first phase, in the fall of 2019, five rows of trees, Turkestan elm and hazel, as alley cropping practice, were introduced, spaced at 136, 120, 90, 125 and 100 m. The Turkestan elm was planted at 8 m from each other in a row, and the hazelnut at 4 m. To stimulate the height growth of the seedlings, they were introduced into 1.20 m growth tubes. To fill the rows, in the spring of 2023, between elm and hazel species, white poplar, greyish oak, red oak, cherry plum, dog rose were planted, setting the distance between species at 1 m. An area of 38 ha within the farm was completely surrounded by hedgerows consisting of two rows of Turkestan elm, installed in 2016 and honey locust, installed in 2018 and 2019 and later supplemented with willow, white poplar, cherry plum. The windward side of a greenhouse was protected by the installation of four more rows of hazel and walnut in the spring of 2022, alongside the originally planted hazel row. Also, in the central area, which corresponds to the entrance to the farm, various species, both resinous (various species of spruce, fir) and deciduous (hornbeam, beech, linden, willow) were introduced on an area of approximately half an ha.

The forest species (Turkestan elm and honey locust from the hedgerows, as well as elm in alley cropping) installed the earliest reached large sizes, up to 10 m in hedgerows and 5 m in alley cropping, fulfilling the goal for which were installed, to protect the farm from strong winds and to improve the microclimatic conditions. Also, by introducing as many and diverse species as possible, the conditions for increasing biodiversity and carbon storage are met.

Keywords

alley cropping; hedgerows; agroforestry system; forest species; microclimatic conditions.

Contributions to the knowledge of downy oak forests in the territory of the Republic of Moldova

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Abstract

Climate change is a challenge for all of humanity, especially for scientists from whom urgent solutions are expected. Recently, ambitious initiatives are being taken to expand the areas covered by forest, to regenerate and rehabilitate existing forests. Such an initiative in the Republic of Moldova is fixed within the National Forest Extension and Rehabilitation Program for the period 2023-2032 approved by Government Decision 55/2023, which proposes for a period of 10 years to carry out extensive activities of planting of trees/saplings and rehabilitation/promotion of forest vegetation on an area of at least 145 thousand hectares. However, poorly executed planned forest expansion and rehabilitation could have a long-term negative impact on biodiversity and increase CO2 emissions. One of the issues is regenerating downy oak forests and obtaining acorns for direct seeding or nursery production. This limits the expansion of downy oak forest areas. Therefore, it is opportune to know the current state of the downy oak forests, which on the territory of the Republic of Moldova, are located on the border of the northeastern area, in the area of interpenetration of forest-steppe and steppe forest vegetation. For the most part, downy oak forests are spread on the outskirts of Codriri in the forestry enterprises Nisporeni-Silva, Hîncești-Silva, Tighina. This paper provides an analysis of recent studies in the Republic of Moldova regarding the area of downy oak forests and their distribution on the territory of the country, the current state and problems of downy oak forests. In particular, we focused on the characterization of these forests based on the latest available planning materials at the Institute of Forestry Research and Development in Chisinau. We created the map of downy oak forests by natural areas (forest-steppe, steppe), resort types, forest types. Finally, there is a critical discussion about the current state of downy oak forests in the territory of the Republic of Moldova, as well as the challenges for future research.

Keywords

downy oak; forest structure.

Acknowledgments

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Index for degree of restored riparian forest habitat

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Abstract

An assessment of restored riparian forest habitats *91E0 and 91F0 was carried out. The sites are located along the Danube River and the Kamchia River in Northern Bulgaria. Afforestation of Quercus robur, Ulmus laevis, Fraxinus angustifolia or mixed forests of these tree species were studied. The financing of these afforestation is under various projects with national or European financing (Operational Environment Program, LIFE and others). In sample plots are, 5 main parameters were evaluated: 1. Degree of naturalness, 2. Presence of invasive plant species; 3. Forest structure; 4. Anthropogenic impact; 5. Origin. A 10-point scale from 1 to 10 is used. A tried-and-tested methodology for assessing forests in the old age phase was followed. The proposed methodology for the index of restored habitat aims to assess the imitation of natural processes. Results have been achieved from new afforestation, seed regeneration or measures to limit foreign invasive plant species is assessed. Methodology can serve in the evaluation of different forest ecological expertise, for evaluation and comparison of good forest restoration practices, in pre-project studies of new restoration activities.

Keywords

methodology; assessment; index; restored habitat; riparian forests

Some aspects regarding the main indicators for characterization of forest ecosystems in the Bârgău Mountains area

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Abstract

Management of the huge natural resources of forest ecosystems on a new scientific basis, based on extensive research, mathematical modelling of the laws of biological functioning, by interacting with environmental factors and the anthropic factor, can positively or negatively influence ecosystems, is a topical issue at national, European and global level. The inventory work carried out at the local level took into account the methodology of the national inventory of stands in the work of the National Forest Inventory. The sampling used at the level of Bârgău Mountains is based on a systematic network of squares with 4 km side (identical to the national network). The results obtained refer to the dimensioning of the network by calculation in order to ensure an optimal layered and multiphase repetitive sampling. The estimation of the forest area and volume by species from the Bârgău Mountains area, by age classes, by stand density categories and others. The present research also has a pronounced practical character, because, based on a rich research material, a number of indicators of forest production activity and a unitary estimation of wood resources in the area of Bârgău Mountains are used.

Keywords

Bârgău Mountains; forest ecosystems; statistical indicators.

Production of grand fir provenances in the Czech Republic

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Abstract

Grand fir is one of the most important introduced tree species used in European forestry. Due to its high biomass production compared to other native tree species, it has become an interesting tree species for forestry. It can be used as a substitute tree to increase wood mass and biodiversity in forest stands. A series of 6 research plots have been established under the auspices of IUFRO to identify suitable provenances in our area. Two research plots were measured and evaluated in terms of dendrometric variables (DBH, tree height, stem volume) and morphological characteristics (stem shape, branch thickness, branch density, defoliation and health status). Results from the 40-year study plots indicate significant biomass production in the Vancouver Island (British Columbia) and coastal Washington State provenances. In terms of morphological traits, the results of the provenances are not significantly different and are rather balanced. Grand fir is one of the options for improving forest management conditions in both productive and non-productive forest functions.

Keywords

Abies grandis; high production; introduced tree species; quantitative and qualitative characteristics.

Management goals for mixed beech-coniferous stands from high-productivity sites in Romanian Carpathians

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Abstract

The beech-coniferous mixed stands in the Romanian Carpathians fulfill multiple functions, so the stability of these ecosystems is an essential objective pursued by forest management. This study aimed to establish the most favorable management goals for these forests to continuously fulfill their assigned functions. The productivity of mixed stands is dependent on site conditions but also on stand structure. In this study were investigated mixtures of different ages and structures, located in high-productivity sites in the Gurghiu Mountains. Stands were inventoried in plots of 0.25 - 1.0 ha, totaling 15.3 ha. The mixed stands achieve different structures in the vertical plane, due to the temperament of the species and the silvicultural works applied. For the management of these forests, we have established such multi-aged structures, in which species are mixed in different proportions according to site conditions and the desired production. Goal diameters (i.e., the diameter of the mean basal area tree-d_g) were estimated by regression equations on species and tree generations. The Weibull function was used to determine the distribution in diameter classes by species (i.e., Norway spruce, Silver fir and European beech). The parameters of the function were determined based on the characteristics of the inventoried stands. The mean squared error associated with the function in estimating the diameter distribution ranged from 0.77 to 2.17%.

Keywords

mixed stands; productivity site; multi-aged structures; forest management.

The impact of meteorological factors on forest berry yields in Latvia

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Abstract

In boreal and boreo-nemoral zone, lingonberry (Vaccinium vitis-idaea L.) and bilberry (Vaccinium myrtillus L.) are among the most widespread shrub species, also providing economically most important wild berries. Climate is one of the most significant factors influencing the berry yields over time. Small yields or even absence of berries is often related to spring frosts during blooming time of the plants. Meteorological conditions during formation of flower buds and budding are also of importance. This study utilised data from National Forest Inventory plots (years 2017-2021) about the projective cover of the berry shrubs and presence of berries for bilberry and lingonberry. Only plots surveyed in June or later were included in the dataset. Binary logistic regression, backward stepwise, was applied in the analysis. For bilberry, statistically significant predictors for berry yields are mean soil moisture anomaly index of the previous season, May and June soil moisture anomaly index, maximal air temperature in June, minimal air temperature in May and negative air temperatures in May. Late spring frosts have the most significant impact, i.e., in case of their absence, the probability of berries is nine times higher than in case of negative temperatures in May. At the same time, relatively drier June increases the probability of higher berry yields. Mean air temperatures in August and September of the previous year (time of formation of flower buds) have no significant impact on production capacity of bilberry. For lingonberry, statistically significant predictors are soil moisture anomaly index of previous August, May and June soil moisture anomaly index, maximal air temperature in June, minimal air temperature in May and negative air temperatures in May. Like for bilberry, absence of frosts in May is the most significant factor – if May air temperature has not dropped below zero, the probability of berry yields is six times higher. In the case of lingonberry, relatively higher soil moisture in June increases the probability of berry yields. Contrary to bilberry, mean air temperature of previous August is not significant for lingonberry berry formation.

In summary, while meteorological conditions significantly influence bilberry and lingonberry yields in specific years, lingonberry yields in long-term depend on site type, dominant tree species, stand density and stand age.

Keywords

Lingonberry; bilberry; berry yield; climate; time series.

Unmanned aerial vehicle technology (UAV) – an alternative for tree foliage sampling

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Abstract

Within the ICP Forests programme, tree specific nutrient uptake processes are constantly monitored and periodically evaluated based on foliage (leaves & needles) sampling (Badea et al. 2013, Rautio et al 2020). In the case of Romania this operation was and still is performed specialized forestry personnel using a combination of dedicated tree climbing devices and modified tree pruning equipment. Although successfully used for the last 30 years (with some major improvement over time), the current foliage sampling equipment is starting to show its age and needs to be replaced (especially due to operator safety reasons) with a more technologically advanced, safe and user & tree friendly equipment. As UAV technology has evolved to the point that drones are now successfully used in multiple fields ranging from military to entertainment, the National Institute for Research and Development in Forestry (INCDS) is analysing the opportunity of using an innovative approach for sampling leaves and needles. In this respect a comparison based on SWAT analysis of the current technology used by INCDS versus the available state of the art UAV technology will be highlighted.

Keywords

Monitoring; tree mineral nutrition; foliage sampling; drone.

Detecting the vitality of pedunculate oak (*Quercus robur* L.) trees: defoliation, nutritional status and indicators of oxidative stress

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Abstract

The quantification of forest ecosystem behavior in a changing environment is fundamental for future forest ecosystem goods and services maintenance, enhancement and restoration. Tree vitality or condition can be defined as the ability of trees to assimilate, survive stress and react to changing conditions. Different methods can be used to study stress in plants and to determine the physiological status of trees in a forest ecosystem, and various indicators are used to measure tree vitality. Crown condition, assessed as the percentage of defoliation, is a widely used, but unspecific tree vitality indicator. The nutrient contents of tree leaves are also an important indicator for tree vitality, as healthy growth can be attained only if all nutrients are present in a certain quantity and in the correct ratios; therefore, it is crucial to account for nutrient limitation when studying tree response to stress. Defoliation seems to be related to the nutritional status of trees, as both reflect atmospheric and soil-mediated influences. Finally, various indicators of oxidative stress can be used to detect a decline in tree vitality, as the increase in e.g., malondialdehyde levels is associated with the oxidation of membrane lipids caused by activated oxygen species and with the damage of the tree photosynthetic apparatus. The objective of our research was to assess and compare the differences in the concentrations of mineral elements (N, P, K, Ca, Mg) and the extent of oxidative stress in the leaves of *Quercus robur* L. trees of various crown defoliation classes.

Keywords

Vitality; nutritional status; indicators; oxidative stress; visual assessment.

Dendroclimatic models for the common oak (*Quercus robur*) and the grayish oak (*Quercus pedunculiflora*) in the forest-steppe area of southeastern Romania

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Abstract

Global climate change impacts all regions of the world, including the forest-steppe zones in Romania. In the last decade, the effect of environmental changes in southeastern Romania has been manifested through increasing temperatures and more frequent and intense drought periods. These climate events have an impact on tree growth processes. The objective of this study is to comparatively observe the response of trees to climatic factors in relation to their position within the forest stand. The research was conducted in the Bărăgan forest stand, managed by the BE Bărăgan. The analyzed species are the common oak (*Quercus robur*) and the grayish oak (*Quercus pedunculiflora*). Two research areas were selected for each species, one inside the forest and one at the forest edge. In each research plot, 21 trees were chosen for sampling. From each tree, one increment core was extracted at the height of 1.30 meters using a Pressler borer. The growth samples were processed and measured according to dendrochronological methods. A cubic smoothing spline function with a 50% frequency cutoff at 30 years was applied on individual tree ring width series to eliminate the age trend and any other disturbance signals. For each species, two mean chronologies were developed, one for inside forest stand and one for forest edge trees. The climatic data (monthly average temperatures and precipitation) used in this study were extracted from E-OBS grid database (0.25 x 0.25 degrees). The bootstrap Pearson correlation between monthly temperature and precipitation and tree-ring width index chronologies was computed. Significant differences in radial growth were observed between the oak trees inside the forest and those at the forest edge. The oak tree inside the forest showed a positive and statistically significant correlation between growth indices and precipitation from September of the previous year to May of the current year. On the other hand, the oak tree at the forest edge does not show statistically significant correlations with precipitation in this interval, except for March. As for the greyish oak in the BE Bărăgan area, the radial growth indices show a positive correlation with precipitation in March and a negative correlation with temperatures in June.

Keywords

tree ring width; temperature; precipitation; Pearson correlation; dendroclimatic models; drought.

The monthly surface runoff evolution under climate and land use change in small forested watershed

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Abstract

Small watersheds are prone to the occurrence of extreme events, mainly in mountain regions which are more susceptible to climate changes compared to lowlands. This is the reason why, numerous recent studies focused to appraise the water resources evolution under different drivers of change for the next decades. An attempt of projecting the future evolution of surface runoff was made also in the present study, conducted in a small watershed located in a mountainous area. Using a calibrated and validated SWAT model, four local climate change scenarios and three land use change scenarios, we forecasted the monthly evolution of surface runoff for the 2020–2039 period. Future projections, obtained under RCP4.5 and RCP8.5 compounded with a reduction of 25% and 50% of forested areas showed decreases of up to 75% of monthly surface runoff projected for June–August, the lowest values being obtained especially REMO4.5. The increases are projected starting with September, the highest values of this parameter, being projected for February under CLM4.5, mainly due to the precipitation and temperature increments forecasted for the considered period. These findings emphasize the importance of considering the climate and land use change for the sustainable management of water resources.

Keywords

SWAT; climate change; land use change; monthly surface runoff; small watershed.

Aspects of the oak decline phenomenon within the Sf. Maria- Oradea Forest District, reported to the local climatic and pedological conditions

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Abstract

The phenomenon of decline or weakening of forests is currently manifesting with increasing frequency, affecting new areas and new species. This phenomenon can be assimilated to structural or functional disorders, in which several categories of disturbing or harmful factors compete and interact in different directions and directions and the result of which is the weakening of the vigor of the trees and culminating in their death. Numerous studies have shown that abiotic stresses are among the most important factors in the decline of stands with the oak species, and include especially summer droughts, changes in rainfall, as well as winter and/or spring frosts, their effect being weakening vigor and increasing favorability for the attack of biotic agents (pathogens and insects). The forests studied are located in the Oradea and Marghita area (plain and low hill areas) and are managed by the Sf. Maria Forest District, being mainly made of pedunculate oak and sessile oak, sometimes turkey oak. The research objectives focused on the determination of the health of stands and the vitality of trees, simultaneously with the evolution of the main indicators of the health of declining stands. Were analyzed stands in which various manifestations specific to the phenomenon of decline, located in the forest bodies Pădurea Mare-Marghita and Boboștea. Observations and measurements were made in 10 experimental areas, located in different age classes, and according to the characteristics of the analyzed trees, the degree of injury was determined, drying, and devitalization. In order to establish climate indicators with direct influence on the vegetation status of *Quercus* species in the studied area, were monitored monthly rainfall and temperatures during 2017-2021, and were calculated the Forestry Aridity Index (F.A.I. – [1]) and the Ellenberg coefficient (E.Q. – [2]). The observations made in the period 2017-2021 showed that the stands in question are weak to medium affected by drying phenomena, the trend being slightly upward, the percentage of damaged trees is in most stands between 65% and 85% (most of them being in the poorly and moderately injured classes), and the degree of devitalization was maintained, generally within the same limits. Thus, the most affected tree is found in forest unit 225A of the Pădurea Mare-Marghita, in which it can be stated that it is in the early stages of the decline, a fact also suggested by fluctuations in the degrees of damage, decline, and devitalization. Also, in the case of stands in the 24A and 214B forest units, those indices had an upward trend from one year to the next, and in 2021 they approached the value 1 (the entry threshold in the early phase of the decline). Increasing the affected areas and the number of trees showing symptoms of the decline (debilitation), established by means of the synthetic damage index, is observed in half of the analyzed situations and is directly correlated with the occurrence of climatic extremes in 2021 such as torrential rains with quantities of over 40l/sqm/24 hours, with low rainfall during the recharge period of the soil in previous years, as well as other climatic risk phenomena: hail (1-2 cases per year), strong winds, storms (2-3 cases per year), frosted frost and rain (2-10 cases per year). The aridization trend of the area in question is highlighted by the unusual value of the FAI in 2021 (11.58, compared to the multiannual average of 5.89).

Keywords

aridity index; climatic; decline; devitalization; oak; stands.

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How will the pine forest ecosystems from Banat Mountains adapt to the new climate conditions in the next 80 years?

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Abstract
The climate impact on pines ecosystems may be measured by means of the HYPE software. The climatic modeling software is employed to predict future temperatures and precipitations across the studied territory. After interpreting the data provided by the software, we can predict how forest ecosystems will be influenced by climate change in the future. Different plots across the Banat Mountain range have been studied in order to determine the future existence of pine forest ecosystems. Consequently, two simulations have been designed, leading to two different future climatic scenarios. The first climatic scenario presents a moderate increase in greenhouse gases (rcp-4.5) whilst in the second scenario there is an accentuated increase (rcp-8.5). The analysis which resulted from the data processing from within all three pine stands reveals the fact that the Bocsa Romana and Bocsa Montana stands will be the most vulnerable ones and the Paltinis stand the less vulnerable one. The importance of these results is closely related to how local forest administrators can use such findings in order to apply the best management measures.

Keywords
climate change; future climate scenarios; forest ecosystems; pine species; Banat Mountains.

Occurrence of invasive alien plant species in ICP LEVEL I plots in Romania

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Abstract

The spread of invasive alien species (IAS) has been acknowledged as one of the major factors of biodiversity loss across the European Union (EU) (Ciuvat et al. 2018, Kramer 2020). In this context of climate change, the EU is faced with the need to search for new opportunities to preserve indigenous ecosystems both through national legislation of protected areas and through the mechanisms of the pan-European system of protected areas called Natura 2000. The EU Regulation 1143/2014 on invasive alien species entered into force on 1st January 2015, fulfilling Action 16 of Target 5 of the EU 2020 Biodiversity Strategy, as well as Aichi Target 9 of the Strategic Plan for Biodiversity 2011-2020 under the Convention of Biological Diversity. Romania has recently compiled a preliminary national list of IAS which contains tree species previously used in afforestation of degraded lands (i.e. Eleagnus angustifolia). Within Romania's ICP Forests network of Level I monitoring plots a survey of plant biodiversity was started in spring of 2019 and after the first inventory a database of identified species was compiled and structured on four levels: mosses, herbaceous, shrubs and trees. Analyzing the occurrence of IAS in the monitoring plots showed the presence of some highly invasive species such as Ailanthus altissima, Amorpha fruticosa and Erigeron annuus. The authors highlight the need for raising awareness on the impact of IAS on local biodiversity and taking adequate measures to monitor and control their transboundary spread.

Keywords

invasive, plants, monitoring, occurence, legislation

An additional risk factor for overpopulation with *Agrilus suvorovi populneus* (Obenberger, 1935) in Euramerican poplar cultures - A case study

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Abstract

Agrilus suvorovi populneus, being a species of the Buprestidae family, attacks euramerican poplar and selected willow with a weak state of vegetation in young cultures, installed in inappropriate or physiologically weakened stands due to various causes (drought, prolonged flooding, improper transplanting, repeated defoliation, mechanical injuries, etc.) as well as in older cultures but with poor vegetation status. The long-term practice, for over 20 years, of clear-cutting in small parcels, under 3.0 ha, in euramerican poplar cultures, has led to great fragmentation of the forest massifs in the embankment area, especially those along the inland rivers, fact which determined the appearance of an additional risk factor for the overpopulation of this insect, such as the sudden exposure of the trees to the conditions specific to the edges of the massif, with strong insolation, higher temperatures, high evapotranspiration, very favorable for the development of the insect. In addition, the application of these cuts in vegetation season, when the flight of the insect also takes place, facilitated the overpopulation of the trees with this insect, precisely against the background of increasing their ethanolic attraction. The obtained results offer forest managers the possibility of adopting new regulations regarding the application of clear cuttings in euramerican poplar cultures, in the sense of renouncing the option of small felling areas in the future as well as avoiding the logging during the growing season, which corresponds to the flight of most xylophagous insects, specific to poplar and willow.

Keywords

Agrilus suvorovi populneus; risk; overpopulation; edges; die-back.

Identifying and valuating main ecosystem services provided by forests in Grădiștea Muncelului – Cioclovina Natural Park

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Abstract

EU Biodiversity Strategy calls Member States to map, assess the state of ecosystems and their services and valuate them. Forests provide a wide range of ecosystem services, but their proper assessment and valuation is still a challenge. In this study, the main ecosystem services provided by forests in Grădiștea Muncelului – Cioclovina Natural Park based on their functional categories, as set in their management plans were identified and valuated. Management plans of over 70% of the forests in PNGM-C were analysed. The most important ecosystem services identified (surface-wise), are the ones related to habitat protection and cultural activities. 20 ES were analyses against CLC classes using a simple matrix approach. Two of the highest ranked ES were selected for monetary valuation, namely carbon sequestration and recreation – tourism. The cumulated value of the two ES exceeds 500 million lei for the whole park, the value per ha of forests being approximately 12 500 lei. These values must be regarded with precaution due to the high uncertainties raised by using general data and estimates. More ES will be valuated and presented.

Keywords

forest ecosystem services; forest functional categories; forest management plan; carbon sequestration; forest ecosystem services; monetary valuation; simple matrix approach.

Ash dieback evolution in two representative sites of Romania

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Abstract

Ash dieback caused by the Asian fungus *Hymenoscyphus fraxineus* occurred in 1992 in northern Europe (Baltic area), then gradually spread over almost the entire continent. In Romania, general ash decline symptoms were observed in 2005-2006 in the Moldavian Plateau (Vaslui Forest Directorate) and other areas of the country. After 2010, dieback became chronic in sites with high soil moisture (meadows, valleys, depressions). The present research aimed to highlight the dynamics of the disease in areas favourable to the invasive pathogen. The monitoring of disease was carried out in two areas - the Transylvanian Plateau (BE Tg. Mureș) and the Moldavian Plateau (FD Adâncata, FD Suceava). In the first case, ash health status evolution was monitored in 2016-2022, in several experimental plots. In the second case, after the complete dieback of all the ash trees from the experimental plots, the disease evolution has been recorded by the volume of dead trees harvested in 2010-2022, in the forest district of Adâncata. In both analysed areas, the debilitation and dieback of common ash *(Fraxinus excelsior)* was continuous, but with some annual fluctuations (caused by the evolution of the favouring factors). In comparison, the other deciduous species in the area recorded rare (and limited in volume) drying phenomena during drought periods.

Keywords

Fraxinus excelsior; Hymenoscyphus fraxineus; evolution; site characteristics; climate.

Phoretic mites of *Ips typographus* (Linnaeus, 1758) (Coleoptera:Scolytinae) in the Brașov County: a 3-year case study

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Abstract

Bark beetle *Ips typographus* is considered one of the most important pests of spruce in Romania, found both in pure spruce forests and in mixed forests. In these stands, bark beetle populations are closely related to climatic conditions and establish short-term relationships with phoretic mite populations as well. Phoresy is the interaction between two organisms in which one attaches to another only for the purpose of travel.

The aim of the research was to study the population dynamics of phoretic mites and the complex relationship they have with the bark beetle *Ips typographus* in the Brașov area over 3 years. In order to achieve this objective, four plots were located in spruce stands around Brașov from May to June 2016-2018, where bark beetles were collected using wing-type pheromone traps.

Six species of phoretic mites were identified: *Dendrolaelaps quadrisetus* Berlese, 1920, *Trichouropoda polytricha* (Vitzthum, 1923), *Histiostoma piceae* Kramer, 1876, *Urobovella ipidis* (Vitzthum, 1923), *Cercolepus* spp. and *Proctolaelaps fiseri* Samsinak, 1960. The results obtained highlighted the fact that the phoresy rate varied according to the year of collection of bark beetles. Thus, in 2016 the phoresy rate was 29.6%, in 2017 it decreased to 24.9% and in 2018 it grew to 46%. The location of the mites on the body of the beetles varied according to the phoretic mite species, most were identified under the elytra, elytral declivity and thorax.

Keywords

Norway spruce; bark beetle; phoresy; phoretic mites; population dynamics.

Susceptibility of ornamental Cupressaceae taxa within the INCDS Ștefănești nursery to the attack of *Lamprodila festiva* (Linnaeus, 1767) (Coleoptera, Buprestidae)

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Abstract

In recent years, the insect *Lamprodila festiva* (Linnaeus, 1767) (Coleoptera, Buprestidae), previously found only on spontaneous taxa of Cupressaceae in Mediterranean countries, has started attacking ornamental Cupressaceae taxa. This has caused significant damage in nurseries and green spaces. A measure to limit the expansion and respectively the damage caused by *Lamprodila festiva* is the correct selection of ornamental Cupressaceae taxa depending on the environmental and soil conditions but also the choice of species less susceptible to the pest. In February 2023, 14 ornamental Cupressaceae taxa from the INCDS Ștefănești nursery were analyzed in order to determine which were less susceptible to the pest. Our results showed that the intensity of the attack, frequency of affected specimens, and degree of injury varied depending on the analyzed taxon. The most affected taxa by the pest belong to the genus Thuja, among which the taxa *Thuja occidentalis* "Rheingold", *Thuja plicata* and *Thuja occidentalis* "Aurea" turned out to be the most susceptible. On the other hand, *Juniperus horizontalis* and *Juniperus communis* "Hibernica", although the insect normally develops on spontaneous species of the *Juniperus* genus, were found to be the least susceptible to the attack of *Lamprodila festiva*.

Keywords

cypress jewel beetle; ornamental taxa; susceptibility; Cupressaceae.

The need to carry out the tending operations of forest vegetation from forest shelterbelts and from other agroforestry systems

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Abstract

The influence that forest vegetation has on agricultural crops and/or livestock, as well as the interactions between them, is reflected in the benefits that the newly created agroforestry system brings, namely, ecological, economic and social benefits, some of which prevail in depending on the type of agroforestry system existing in a certain area. Ensuring the continuity of agroforestry systems as well as maintaining and strengthening the role of protection and production of the forest vegetation within them is achieved by carrying out care and management works, respectively carrying out clearing/depressing works, cleaning, thinning, artificial pruning works, crown-forming cuts and hygiene work. The tending operations, correctly designed, adopted and applied, represent an indispensable and effective means for the sustainable management of the cultivated forest. And for forest vegetation in agroforestry systems there must be the same concern for the management of the forestry component. The timely, consistent and proper execution of all tending operations, in all stages of development of the forest vegetation, influences both the increase in the value and resistance of the forest vegetation in the agroforestry systems against disturbing factors, as well as the full use of the production capacity of the site. Failure to carry of these works significantly reduces the beneficial effect of the forestry component within agroforestry systems. The analysis of the state of some forest shelterbelts (as the main type of agroforestry system in Romania) highlighted the fact that the tending operations mentioned above were not carried out on time or at all, which led to the degradation of their state, to the appearance of diseases and pests, to the failure to fulfill certain functions for which they were installed. The application of tending operation of an experimental nature, in forest shelterbelts and in other agroforestry systems, depending on the state and stage of development of the forest vegetation, aims to establish the type of interventions, their character, intensity and periodicity.

Keywords

shelterbelts; agroforestry system; state of shelterbelts; tending operations; protection; production.

The influence of dead wood on the diversity of ground beetles in the Șinca Old-Growth Forest

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Abstract

The forests, including those in Romania, have a great diversity, very little studied, which includes over 50% of the known organisms. There are equally few studies comparing diversity in managed and unmanaged forests. In this work we want to show if there is a relationship between ground beetles and dead wood from two types of forest: an unmanaged forest and a neighboring forest, where human intervention was minimal, such as conservation, from the Șinca Old-Growth Forest. The objectives of the work were: species identification; comparing the spectrum of genera and species in the two forests; establishing the relationship between the amount of dead wood and the number of individuals. To achieve these objectives, 15 circular plots of 500 m^2 each were placed in the field, both in the managed and in the unmanaged forest and in each of them, 3 Barber type traps were placed. The biological material was collected at 2-week intervals, in the periods 4.06.2021-9.10.2021 and 8.04.2022-1.06.2022. Dead wood was inventoried, by species (fir and beech), by type of dead wood (log or stump) and by decay classes. 27 carabid species were identified (25 in the managed forest and 18 in the unmanaged forest), of which 6 were collected in a number of individuals over 100, 6 as singletons, and the remaining 15 species under 100 individuals. The number of individuals was higher in the unmanaged forest, and the number of species in the managed forest. The best represented species of the *Carabus* genus were captured in higher numbers in the areas with a higher volume of dead wood (no statistically significant difference).

Keywords

ground beetles; diversity; dead wood; decay classes; Șinca Old-Growth Forest.

Contribution of the "Alexandru Ciubotaru" National Botanical Garden (Institute) to scientific argumentation and the promotion of forest fund management

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Abstract

The role played by botanical gardens in society is a complex one. Today, in a changing world strongly affected by anthropogenic impact, the tasks of these institutions are amplified and diversified, aiming to contribute as effectively as possible to the conservation of the planet's natural heritage. They fulfill so many functions and carry out so many diverse activities that it is quite difficult to define what a botanical garden means today. However, in a fairly generous and acceptable approach, botanical gardens are considered "institutions that house collections of well-identified living plants used for scientific research, conservation of plant diversity, information, and education" (International Association for Botanic Gardens and Botanical Conservation, 1999). This definition encompasses both large botanical gardens with hundreds of employees and diverse activities, as well as small ones with limited resources and activities. In the European Union alone, there are more than 450 botanical gardens (e.g., 77 in England, 13 in Austria, 25 in Belgium, 68 in France, 78 in Germany, 54 in Italy, 43 in the Netherlands, 16 in Spain, 11 in Romania, etc.). The majority of these gardens are funded by the state, many belong to universities, and only a few are private institutions. Among the most frequent activities carried out by botanical gardens, the following are particularly significant: research on native flora and vegetation, ex-situ and in situ conservation of plant diversity, habitat restoration research associated with reintroduction programs for plant species, maintenance and development of herbarium collections for taxonomic studies, dendrology and floriculture, seed banks, laboratory research including "in vitro" cultivation, ecological education for children and adults, public information using their documentation centers, museums, and libraries, and consultancy in the field of plant therapy. The involvement of botanical gardens in these activities/areas requires their development as centers of scientific research, training centers for young taxonomists, horticulture specialists, and researchers capable of addressing biodiversity conservation and sustainable use of plant resources. "Alexandru Ciubotaru" The National Botanic Garden (Institute) (GBNI) aligns its status, purpose, and activity objectives with international standards regarding the mission of botanical gardens, collaborating with numerous botanical gardens abroad. Since 2002, it has been a member of the Association of Botanical Gardens of Romania (AGBR), which includes all botanical gardens in Romania, and has been affiliated with the European Botanic Gardens Consortium since 2007. At the national level, GBNI plays a significant role as the main institution for fundamental and applied botanical research. Its primary goals and tasks are established by the Law on Botanical Gardens (No. 105 of June 2, 2005). According to the provisions of this law, GBNI's main tasks in the field of plant diversity conservation within the territory of the Republic of Moldova are the artificial conservation of plant diversity (especially rare or endangered species) and other botanical objects of scientific, educational, economic, and cultural importance within the territory of the Republic of Moldova; conducting scientific research in the field of fundamental and applied botany, as well as silviculture; researching the diversity of plant species within the country and developing the scientific basis for their rational use. GBNI's full involvement in the process of conserving and sustainably using plant diversity is driven by the very mission and tasks of a botanical garden, the need to implement international and national legislation on biodiversity conservation, and the duty to influence this policy.

Keywords

botanical garden; forest fund; forest management.

The use of pheromone traps in incipient sources of *Lymantria dispar*. Case study - Socodor Forest (Pannonian Field, Romania)

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Abstract

During six years of field and laboratory work, between 2004-2009, the research on the incipient sources of *Lymantria dispar* was completed with some new results, applicable on a large scale in forest protection: the criteria for classifying the surfaces in the "incipient source" category and the methodology of working with pheromonal traps (a specific type of pheromonal trap was designed for which the method of installation, priming, removal and the necessary per ha). The practical application of these results in the Socodor forest, in the period 2010-2022, showed a doubling of the return time of the defoliator outbreak, from 6-7 years normally to 14 years, a decrease of the surface affected by high and very high-level infestations that required control treatments and an increase in the populations of oophagous parasitoids.

Keywords

oak forest; spongy moth; incipient infestation; pheromonal trap; field methodology.

Establishing the effectiveness of the treatments for powdery mildew in the Mihai Viteazu Nursery

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Abstract

Introduction. The modern trends in the cultivation of oaks seedlings try to balance the relatively contradictory requirements: on the one hand, the need to make production more efficient, by obtaining quality seedlings at a high production rate, and on the other hand, the ecological requirements regarding compliance with the conditions of medium.

Due to the high density of saplings per surface unit associated with the action of some abiotic stress factors, the vigor of the saplings is weakened, the most frequent problems of young cultures of oak stands being caused by powdery mildew, produced by pathogens of the genus *Erysiphe* ssp. These pathogens are increasingly difficult to control, due to the withdrawal of highly toxic fungicides, which are highly polluting for the environment.

Material and method. Repetitive treatments and variants with the new generation fungicides Ortiva Top and Talendo were applied in an experimental block in the Mihai Viteazu Nursery, and the distribution of the seedlings was established according to the stratified degrees of attack.

Results. In the experimental block with manure, after the application of the treatments, in the treated variants the weakly attacked seedlings predominate, followed by the non-attacked ones. In the control variant, strongly attacked seedlings predominate, followed by those not attacked, medium attacked and weakly attacked.

Also, the attack evaluation method was used according to the degree of damage to the leaves, this evaluation method showing similarities with the infection values obtained by the method of attack degrees, this can be considered for future comparative determinations with the methods used up to now.

Conclusions. From the analyzes carried out regarding the establishment of infections with pathogens of the genus *Erysiphe* spp., it can be stated that the fungicide with the highest efficiency is Talendo in a concentration of 0.112 ml/0.5 l water/5m^2 (224 ml/1000 l water/ha).

Keywords

fungicides; sessile oak; treatments; infections.

Biological control of *Lymantria dispar* (Lepidoptera: Erebidae) populations with entomopathogenic fungus *Entomophaga maimaiga* (Entomophtorales: Entomophtoraceae) in Romania

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Abstract

In recent years, in forests of southern Romania, some *Lymantria dispar* outbreaks have been stopped by the appearance of epizootics caused by the entomopathogenic fungus *Entomophaga maimaiga*. Experiments conducted in the laboratory involved obtaining and preserving a mycotic product, as well observations on the virulence of *Entomophaga maimaiga* spores. Experiments conducted in the field aimed at developing practical methods for inoculating *Entomophaga maimaiga* spores, observations in the effect of qualitative and structural stand characteristics and environmental factors in the occurrence of *Lymantria dispar* larvae mortality. A biological product was prepared from *Lymantria dispar* dead larvaes, with long storage time, high mortality and specificity, which can be used for biological control. A practical method of inoculation in the field of *Entomophaga maimaiga* spores was developed, with readily available technical means. In the stands where mortality has occurred, the specific environmental conditions, the occurrence of re-infestations, the effects of defoliation on tree growth and stands evolution were monitored. Given the current restrictions of control products, the appearance of entomopathogenous fungus *Entomophaga maimaiga* in the spectrum of biological agents provides an important tool for controlling the *Lymantria dispar* outbreaks and reducing the damages to deciduous forests.

Keywords

Entomophaga maimaiga; Lymantria dispar outbreaks; biological control.

Dynamics of Chemical Traits of Downed Dead Wood in a Temperate Old-Growth Forest

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Abstract

Old-growth forests (OGF) are considered paramount for the local biodiversity and are defined by their high quantities of dead wood. Acting like a nutrient reservoir and home for a multitude of different organisms, dead wood is such a paramount factor in the ecosystem that the survivability of hundreds of species is endangered when it is removed or extracted. The interaction between the scavengers and the dead wood relies heavily on its chemical traits, which in turn depends invariably on the originary species, diameter of the dead wood piece or the time since its fall. This work aimed to study in detail the chemical composition of the dead wood originated from the two dominant species (Silver fir and European beech) of an old-growth temperate forest in Șinca, Romania, one of the few remaining old-growth forests in Europe. Different diameters (1 to 25 cm) of different ages of dead wood (from 1 to >4 years) were selected to perform a complete ionomics study along with carbon and nitrogen composition. Our results unveiled that while the Carbon/Nitrogen ratio decreases as the dead wood gets older, different cations such as Si, Ca or K significantly differ between species. Moreover, different cations also show multiple changes as the diameter of the piece increases. Our research shows a highly dynamic dead wood, with huge differences not only related to the species, but also to its size and age. These results are a step further in the understanding of the traits of the dead wood, and its importance in the biodiversity and the global nutrient and carbon turnover of an endangered ecosystem such as old-growth forests.

Keywords

virgin forest; carbon cycle; Fagus sylvatica; Abies alba; decay stages; Carpathians Mountains.

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Abstract

Soil biodiversity is essential for forest ecosystem functioning as they play key roles in litter decomposition or nutrient recycling. However, perturbations due to both natural (drought/fire/pest) and anthropogenic (thinning/clear-cut/slash removal) sources can lead to strong impacts on soil biodiversity and associated ecosystem services. In the context of climate-smart forestry (CSF) development to maintain sustainable forests, our knowledge about soil biodiversity responses to forest perturbations needs to be strongly improved. In the framework of the H2020 HoliSoils project, we established three study sites in oak-dominated forests located in Spain (*Quercus faginea*, Gámiz), France (*Quercus pubescens*, Saint-Christol d'Albion) and Romania (*Quercus robur*, Brasov) to study the impact of tree removal intensity on soil biodiversity. The experimental design included five treatments (control, 50% thinning and clear-cut with or without slash remaining on the forest floor) replicated eight times in each country. The first results recorded in Spain pointed out a negative effect of both tree and slash removals, whatever the soil biota group considered (microorganisms, microfauna, mesofauna or macrofauna). These negative effects were recorded after one month and amplified after nine months. In addition, the intensity of these effects increased with organism size. For example, a clear-cut coupled with slash removal induced 44% and 98% reductions in soil bacterial biomass and soil macrofauna abundance, respectively. Interestingly, no differences were reported between control and 50% thinning plots with slash remaining on the forest floor. The next steps will include a comparison of response patterns between the three study sites and a survey of these responses over longer times.

Keywords

soil biodiversity; forest management; soil fauna; soil microbial communities; resilience.

Forest Ecosystem Services: Potential of Spruce Forests for Human Health Improvement

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Abstract

Humans have traditionally valued and fostered time spent in nature, especially forests, in a variety of ways. In recent years, multiple studies in the area of ecosystem services (ES) have produced insights that describe and assess all the commodities and advantages that nature provides. In terms of ecosystem services, trees and forests play significant socio-cultural roles throughout multiple civilizations across the world in addition to the main forest-wood sector. An increasing collection of multidisciplinary research on the benefits of forests and trees for various aspects of human health is currently receiving attention. Various studies have shown that being in forests can relieve stress, lower blood pressure, and enhance the formation of lymphocytes that are important for a variety of bodily functions. Volatile organic compounds (VOCs), also known as phytoncides, are considered to be the primary forest component that improves human health. This research focuses on the investigation of present VOCs in the needles of Norway Spruce (*Picea abies L.*) growing in Tara National Park in Serbia. The phytochemical screening has been done using gas chromatography coupled with mass spectrometry (Headspace-GC/MS). Major detected VOCs were limonene, camphene and α-pinene. These VOCs, classified as monoterpenes, were previously identified as having sedative, anti-inflammatory, and anticancer properties. The findings presented here form the basis for further investigation into how Norway spruce forests could affect human health and how to reinforce the socio-cultural significance of these forests in terms of ecosystem services.

Keywords

spruce; VOC; Picea abies; forest therapy; terpenes;

The impact of defoliation caused by *Stereonychus fraxini* (De Geer, 1775) beetles on the radial growths in forest ash stands in the east of country

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Abstract

The appearance of outbreaks of the primary defoliator *Stereonychus fraxini* in the past years, which caused injuries of economic importance, imposed measures of knowledge of pest biology in order to monitor and even control it.

The research aimed to understand the influence of defoliation caused by the *Stereonychus fraxini* beetles on the growth and vitality of forest stands with ash trees in their composition or ash forest stands.

In the field, a network with permanent control surfaces was materialized, from which biological material was periodically collected throughout the vegetation season for all stages of insect development, for laboratory analysis.

Defoliation causes a sensible reduction in growth of trees in forest stands. Complete, unrepeatable defoliation has important consequences on tree vitality, especially in the case of early defoliation, causing a 50-70% reduction in the vegetative mass compared to the control trees unaffected by defoliation; the effect of defoliation manifests differently, depending on the age of the stands, being more pronounced in young stands than in older ones; repeated defoliation within the same year causes partial or total drying of the trees towards the end of the vegetation season.

Prevention of defoliation is possible through pest control methods. Pest control treatments manage to prevent defoliation and to put an end to outbreak of insects.

Keywords

defoliation insects; ash plantations; radial growth.

Contributions on the ellaboration of the Romanian National Catalogue of Virgin and Quasi-virgin Forests

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Abstract

The National Catalogue of Virgin and Quasi-virgin forests of Romania represents an instrument for the conservation of the most valuable forests, with the highest degree of naturalness. The Catalogue was established by the Ministry of Environment, Waters and Forests by the Ministry Order 3397/2012. Although the Catalogue was filled each year with new surfaces, in 2020 the Ministry decided to finance an inventory-like campain covering the entire country. Our Institute paticipated with the inventory and inscription in the Catalogue of the forest from the Western part of Romania, respectively 15 quasi-virgin forest polygons from the Caras-Severin County – 1147.06 ha and 8 quasi-virgin forest polygons from the Hunedoara County – 1366.35 ha. The final version of the National Catalogue in December 2022 comprised 8529.80 ha of virgin forests (721 forest sub-parcels) and 62497.64 ha of quasi-virgin forests (3885 forest sub-parcels).

Keywords

virgin forests; forest naturalness; forest conservation; nature conservation.

Methodological aspects regarding the inventory, mapping and evaluation of conservation status of the Natura 2000 forest habitats from Cheile Nerei – Beușnița National Park

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Abstract

Our research is part of the process of revision of the management plan of the Cheile Nerei – Beușnița National Park, located in the SW part of Romania. All forested areas are inventoried and mapped, the Natura 2000 habitat types are then identified and described in the field. We use as first sources of information the forestry management plans of each Forest District which administrates forests in the National Park, and, also, the previous management plan. The fieldwork covers as much as possible the surface of the studied protected area; a complex field sheet, containing many information on the ecosystems` architecture, is filled in representative locations. All anthropic impacts are recorded in the field and described in order to provide information on the conservation status of the respective habitat. All the information is processed in order to issue the management measures for the forest habitats.

Keywords

nature conservation; national park; Natura 2000 forest habitat; antropic impacts; management measures.

The Arboretum from Mihăești - a rich collection of monumental trees

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Abstract

Monumental trees (old trees, trees with large girth or with great height) are very important as cultural legacies and in various ecosystems are considered habitat trees. They represent an important information source for the ecosystem where they grow.

The objectives of the research were to identify, to locate, to measure and to assess the state of health of the monumental trees from Mihăești Arboretum. The selection was based on the "monumentality" aspects of trees, taking into account dendrometric parameters. It has been identified 33 monumental trees, belonging to 7 native and 11 non-native species. The most frequent species among the monumental native trees is *Quercus robur* and among the non-native trees is *Quercus rubra*. In terms of health status, 73% of the measured monumental trees are in very good condition, 21% are in good condition and only two of them (from native species) are in poor health condition.

Keywords

health condition; monumental trees; native species; non-native species; old tree;

Towards measures aimed at mitigating the consequences of climate change in the Czech Republic in spruce forest stands of mountain forests

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Abstract

In the Czech Republic, in conditions of Norway spruce mountain forests, there were breeding programs focused on the current partial population recovery of Norway spruce, Ore Mountains ecotype; the source material was obtained from rare individuals which – thanks to their relative resistance – survived several periods of heavy immission (Sulphur oxides) load in the recent past. The implementation of such rescue programs requires, among others, the application of proven vegetative propagation technology of Norway spruce, i.e. the maintenance of their *ex situ* conserved clonal variants. In this information, we present a brief report about some of the current research activities of the Ore Mountains Norway spruce ecotype preservation and reproduction. These efforts are aimed at Ore Mountains´ forest restoration with this native spruce ecotype after the above-mentioned periods of serious immission damage to this Czech mountain area. Nowadays, the increased efficiency of donor tree vegetative propagation is highly required, so that the material derived from older individuals, growing within spruce subpopulations, could be used successfully. These measures also represent a significant contribution to solving consequences connected with running climate change.

Keywords

Czech Republic; Norway spruce; ex situ conservation; vegetative propagation; climate change.

Variability of pedunculate oak (*Quercus robur* L.) in a common garden experiment in Eastern Romania

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Abstract

In the actual context of climate change, trees' adaptability and growing conditions are significantly negatively influenced (oak species fructification is becoming increasingly rare, with a periodicity of up to 10 years). Also, new methods of ensuring genetic and adaptive plasticity, phenotypic variability, and forest genetic resources production are tested by various conservation methods.

The aim of the research was to determine the phenotypic variability of pedunculate oak in a comparative trial installed in the eastern part of Romania and also specie adaptability in contrast with genetic or climatic factors to identify the most productive and adapted provenances.

This research was performed by studying nine national oak provenances, which are installed in a common garden from Traian Forest district, near Bacau county, using different instruments in the field (calliper, dendrometer and protocols) following methods in the field (measurements and observations) and in the laboratory (statistical analyzing and interpretation of results).

From 9 provenances, only 2 of them (5 – Campina and 6 – Filiasi) are the most adapted also by high values of metric traits (dbh, total height and pruned height) and observed traits (insertion angle of branches, thickness of branches and stem shape of trunk shape). Required phenology process, which is used especially to assess how plants react to various influences like climate changes and to quantify forest species adaptability and how phenophases change in time, another two provenances (1 - Racari and 8 – Draganesti Olt) registered the shortest period of flushing. These provenances (1 – Racari, 5 – Campina, 6 - Filiasi and 8 – Draganesti Olt) are the most valuable and adapted in the Traian comparative trial. It is recommended to improve resilience management of them to produce high-value genetic forest resources and also adapted to the actual climatic conditions from different regions of the country.

Keywords

phenotypic variability; comparative trial; provenances; forest genetic resources.

Effect of ozone exposure on fruit consumption by the Eurasian magpie *Pica pica* in a suburban environment

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Abstract

Tropospheric ozone (O3) may alter tree physiology and modify fruit ripening; therefore, it may also influence the behaviour of wild frugivorous species. The Eurasian magpie *Pica pica* is a resident bird species and is a widespread species in farmlands and anthropized environments. This corvid shows a wide trophic spectrum, including fruits, invertebrates, small vertebrates, and carcasses. In this work, we tested whether different O3 concentrations result in different fruit consumption rates by a suburban population of magpie. The test was performed at the Ozone-FACE (Free Air Controlled Exposure) facility in Florence (Central Italy), consisting of nine plots where grapevine plants (*Vitis vinifera* L. cv "Cabernet sauvignon") were exposed to three O3 levels (ambient, AA; 1.5 times ambient O3 concentration, x1.5AA; twice ambient O3 concentration, x2.0AA). Camera-traps (N = 3, ©Browning SpecOps) were located in front of each treatment area and kept active for 24 hours/day and for 5 days periods throughout a total of 3 months to monitor grape consumption by birds. Camera-traps were set to capture a 60 sec video at each animal passage.

We collected a total of 38 magpie videos. Magpies were the only grape consumers, with a total of 6.73 ± 3.26 passages (mean ± SD) per hour, with no differences across different plots and different O3 treatments. Activity of magpie peaked in early morning, with a second smaller activity peak at sunset. The grapes in the AA treatment were consumed significantly faster than those in the x1.5AA treatment, which were, in turn, consumed faster than those in the x2.0AA treatment. After 3 days of exposure, 94, 53 and 22% of the grapes from AA, x1.5AA, and x2.0AA treatments were eaten, respectively. Instead, grapes were eaten in x2.0AA only when the O3 fumigation was turned off.

To conclude, increasing ozone concentration limited grape consumption by the magpie. Therefore, our results provided valuable insights to mitigate human-wildlife conflict in agricultural and suburban environments.

Keywords
Corvids; crop pests, Ozone-FACE, Pica pica; seminatural environment.

Survival of Eurasian beavers in limiting habitat conditions

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Abstract
The Eurasian beaver (*Castor fiber*) reintroduction in Romania is an obvious success, in that the population and the species range have registered significant increases. As the optimal and suboptimal areas were occupied, young specimens were put in a position to populate areas that, according to the habitat assessment methodology, are classified as "unfavorable". This fact denotes a large ecological amplitude of the species, conferred in part by it`s capacity to modify the habitat conditions and the extended trophic palette that it can exploit.
The study is based on the observations made in the period 2014-2022 on 11 beaver families established in habitats with limiting living conditions, along the rivers Olt and its tributaries, Trotuș and Buzău. Altitudinally, the locations are located in the range of 450-905m.
The main limiting factors identified are: trophic (T), hydric (H), altitudinal (A). Of the situations analyzed, 72.8% are cases where the limiting factors are combinations of the mentioned factors: 9.1% T-H-A, 36.4% T-H and 36.4% A-H.
In these conditions, the growth and dispersion of the population is very limited, registering deaths above the normal limit both in the first months of life and in adult stage.

Keywords
Eurasian beaver; Castor fiber in Romania; ecological amplitude; limiting habitat condition; beaver survival.

Building up a harmonized approach for brown bear genetic monitoring: facets of non-invasive sampling

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Abstract

Brown bear conservation relies upon long-term monitoring and dependable methods for estimating population abundance and demographic parameters. Moreover, maintaining diversity and gene flow are significant conservation challenges for endangered and large bear populations worldwide. Despite the advantages and the advance of non-invasive genetics, practitioners have detected a high variability in the techniques and model parameters for tracking demographic and distribution changes, hindering the replication analysis and results comparison. This research aims to provide a clear guideline on estimating the minimum number of individuals, the genetic structure, genetic diversity, and the migration rates of brown bear populations by using non-invasive approaches combined with spatial capture-mark-recapture. Our work comprehends a systematic review of the recent developments and methods used for monitoring large carnivores at the population level worldwide. Thus, we ranked and selected those techniques reporting the best quality and built a methodological scheme accounting for practicality. The screened techniques, parameters, and software have generated a decision tree to be used as a practical tool for conducting stepwise analysis for genetic monitoring at the population level. We believe our work contributes to filling current information gaps in population genetics and promotes the standardization of measurements for investigating demographic, genetic structure, and connectivity conservation. Furthermore, the results apply to wildlife managers for monitoring brown bears in Romania, addressing one of the main objectives in implementing the country's national action plan for brown bear conservation.

Keywords

non-invasive sampling; individual-based analysis; population genetics; spatial capture-mark-recapture model; brown.

Measurable parameters study from the perspective of 2 evaluation methodologies on red deer (*Cervus elaphus* L.) trophies from Romania

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Abstract

This paper analyzes the particularities of the measurable parameters of red deer (*Cervus elaphus*) trophies, from the point of view of their performance. The data comes from the top class of medal worthy trophies. The selection and ranking of evaluation parameters in determining the final score is carried out by means of calculation formulas that can vary in complexity but also by assigning coefficients for each individual parameter. The data set is analyzed in the present study both from the perspective of the C.I.C. methodology (International Council for Game and Wildlife Conservation) as well as Rowland Ward. The very important additional element analyzed in the study is represented by the determined age. The trophy evaluation methodology represents a specific vision regarding the identification, appreciation and promotion of certain parameters, considered by specialists to be the most important. The evaluation of trophies framed in this way expresses the quality of the game and implicitly the hunting units from different countries and regions, also having cultural, social and economic connotations.

Keywords

Cervus elaphus; hunting trophies; Romania.

A framework for bridging genetic studies outputs and practicality

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Abstract

Genetic data has reportedly been mentioned as an essential tool for integrative wildlife monitoring. Despite research articles growing in number and diversity, there is an increased difficulty for practitioners and decision-makers to find similar case studies and management practices for their immediate problems. It seems there is a gap between research and fieldwork nowadays, and wildlife genetics is no exception. If publications are not informing conservation or management through clearly stated recommendations for action or policy and are not used in these matters, they become redundant. We conducted a meta-analysis on wild populations of animals monitoring using genetic datasets. We found that, at a global scale, North America and Europe are well covered by studies usually designed at the country level (86% at the country level, 9% and 5% transboundary between two or three countries, respectively). Microsatellites were the most used genetic method (73%), while SNPs (6%), mtDNA (4%), a mixture of the previous three methods (11%), and others (6%) were less represented. Assuming that authors' affiliation might influence the chance of a publication to make specific recommendations, we found that practitioners had the most negligible proportion of participation (9% of studies). Measures or management practices suggested by authors based on study results were classified as specific (36%), generic (42%), and 'on hands' (22%), the latter referring to a lack of mentioning management implications and leaving study results in the hands of decision-makers. From decision makers' perspective, specific measures could be directly transferred into practice; generic ones could be useful for developing conservation and management strategies; finally, 'on hands' studies, results could be considered in building complex management schemes. This meta-analysis aimed to enhance the transfer of science into practicality and bring some visibility to measures suggested by reviewed studies.

Keywords

wildlife; management; genetics; meta-analysis; conservation.

The use of hydraulic modeling to assess the impact of land use on flood dynamics

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Abstract

The present study aims at the influence of the land use from the riparian zone of large rivers with potential flood risk (APSFR) on hydraulic parameters. An experimental campaign was carried out based on 3 land use scenarios (i) the current situation of land use, (ii) all forests considered arable land, (iii) all land considered forested and 2 flood hydrographs. Based on hydraulic simulations, changes in floodplain land use structure, expressed in the model by changing roughness coefficients, can lead to significant changes in flood propagation, highlighted by changes in maximum water level and velocity, or maximum flooded area. These changes in the hydraulic regime of the large rivers are important aspects, which must be taken carefully considered into the urban and regional development plans design.

Keywords

APSFR; land use; hydraulic modelling; roughness coefficient; water velocity; water depth; water width; floodable area

Patterns of forest species associations: a case study in a sapling community

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Abstract

Spatial ecological patterns of species distribution can reveal essential information on the functional relationship between species or species and their environment. Various approaches can be used to assess species associations, and our study aimed to compare three methods at different scales: the co-occurrence indices for binary presence–absence data, principal component analysis on species abundance and point process analysis. We aimed to better understand the species' co-occurrence patterns and notice if the three methods captured similar spatial distribution trends. Our observational study of the analysed sapling community displayed several positive relationships between species (e.g., the association between ash and linden). However, many relationships were inconsistent across different scales.

Furthermore, attraction between species was more prevalent than repulsion. Overall, there is a positive association trend, with more relationships being significantly positive across all scales. This trend is consistent with other recent studies of tree–species interactions. Nonetheless, the results suggest that the scale significantly influences the spatial patterns of associations. Positive associations tend to be more prevalent on larger scales, while negative associations are more commonly found on smaller scales, regardless of the analysis method used. While the PCA results are less consistent, the point process analysis allowed us to detect more refined patterns of species associations based on the distance of their interactions. In addition, the binary presence–absence analysis provided solid results, with a coarser spatial perspective but with significantly less sampling effort.

Keywords

Interspecific association; species co-occurence; Jaccard index; spatial patterns; similarity coefficients; associations indices; sapling communities; species interaction.

The evolution trend of stands on degraded lands in the forest-steppe site, in the context of climate change

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Abstract

The evolution of stands on degraded lands in Romania has been the subject of previous or more recent researches, carried out in the network of research plots on long-term. The paper presents synthetically the evolution of pine forestry ecosystems on degraded lands in the forest-steppe area, in relation to their composition and environmental conditions, with the aim of highlighting the types of efficient forestry ecosystems on different categories of degraded lands. Following the evolution of these vulnerable ecosystems is necessary to capture the moment and causes of decline and their succession tendency in the context of climate change. The researched stands aged of 60-70 years are mainly composed of both Scots and Black pine, sometimes mixed with deciduous trees introduced from planting or through additions and natural regeneration. The evolution of the stands takes place in close connection with the environmental conditions, the silvotechnical works carried out, under the effect of abiotic factors (drought, wind, snow and so on) and disturbing biotic factors. Their consequence was the reduction of the consistency, the modification of the composition, the regeneration of some hardwood species, the disruption of the structure, along with their advancing in age. In general, the stands have a vertical double-storied structure and the distribution of the number of trees by diameters categories highlights the concentration of a large number of trees from hardwood species in the lower categories of diameters. This event is a consequence of the fact that the pines suffered injuries caused by wind, snow and drought quite often, the trees being affected in a rather large proportion by felling and breaking. The events generated led to the thinning of the stands and the triggering of the natural regeneration of some hardwood species, highlighting the succession trend of the stands.

The obtained results offer particularly valuable information for the scientific substantiation of the silvotechnical measures necessary to ensure the continuity and regeneration of old pine stands on degraded lands, little known, but very important for sustainable management in the context of climate change.

Keywords

climate change; degraded lands; forest-steppe; pine stands; succession.

Prediction of above-ground, below-ground, stem, branch and stump-root biomass using ALS data and machine learning algorithm

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Abstract

The forest is a major carbon sink in the terrestrial ecosystem, accounting for nearly 72% of terrestrial carbon storage in woody biomass and soil. Determining the amount of biomass in a forest stand is necessary for property managers to make informed decisions about the value and use of their forest land. The aim of this study is to develop machine learning models for forest biomass determination based on NFI plot data, ALS data with a minimum point density of 4 points per square meter and other freely available cartographic materials. Forest biomass models have been developed for parameters such as above-ground biomass (AGB), below-ground biomass (BGB), trunk biomass (SB), branch biomass (BB) and stump-root biomass (SRB). The dataset created from NFI, ALS and other datasets is randomly divided into training dataset (80% of data) while 20% is left for model validation. The coefficient of determination for all developed models ranges from 0.76 to 0.85, and RMSE values from 1.44 (SRB) to 35.05 (AGB).

Keywords

national forest inventory; carbon stock; eXtreme gradient boosting; ALS; biomass.

The analysis of limiting pedological factors for the installation of forestry vegetation and pedo-ameliorative measures for polluted lands from pheasant farms

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Abstract

The pheasantries or pheasant farms were one of the National Forest Administration-Romsilva activities that were recently decommissioned, requiring the capitalization of the lands on which they were located. The paper presents the results of the soil analyzes and their interpretation in the sense of determining the limiting factors and pedo-ameliorative measures for the installation of forestry vegetation on the land of the former pheasantry in Pauşa commune, Bihor County. In order to substantiate the afforestation solutions, detailed soil analyzes were carried out through which the physico-chemical characteristics of the soil were determined. The analyzes carried out showed that the soil has an excess of organic matter (excrements and food residues from pheasants) in the first 30-40 cm. The excess of potassium, phosphorus, and carbon and the lack of nitrogen showed that organic matter is difficult to decompose and do not allow the accessibility of nutrients for forestry species (C/N ratio>26, K and P values can reach 1000 p.p.m). The index of textural differentiation (Idt=1.8-1.9) highlights a contrasting clay-dusty texture, which leads to the worsening of the internal drainage and aeration conditions, to the accentuation of pseudogleyzation processes, also making it difficult to decompose the organic matter. These limiting characteristics determine the need for chemical pedo-ameliorative measures (by amending and enriching the soil with nitrogen) and mechanical (by scarification and deep plowing of the soil) with the role of stimulating microbiological activity in the soil, accelerating the decomposition of organic matter and creating optimal conditions for the establishment of forestry vegetation. After a period of two years from the pedo-ameliorative works, it is recommended to afforest the land with species suitable for the environmental conditions, which will ensure biodiversity, the stability of the newly created stand, and productivity that reflects the edapho-climatic conditions from the site.

Keywords

limiting pedological factors, organic matter, C/N ratio, index of textural differentiation, pedo-ameliorative measures

The status index gradient variation of the transversal hydrotechnical structures from one torrential event perspective

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Abstract

Torrential watershed management is a long-term measure for the protection of socio-economic objectives as well as the improvement of degraded lands. Torrential watershed management is accomplished through structural and non-structural measures aimed to mitigate and control runoffs and erosion. These processes can be accentuated by climate changes, the frequency and intensity of torrential flows being unpredictable. Transversal hydrotechnical structures are located in the river beds, in various conditions of torrentiality and environmental, projected to mitigate the impact of torrential flows, showing high vulnerability to various damages and dysfunctionalities. Due to these factors, the torrential structures should be systematically and continuously monitored. This research aimed to elucidate the association between the deficiencies of the 114 transversal hydrotechnical structures and the impact of a torrential event in the Tigai Valley, located in the Tarlung hydrographic basin in Brasov County. The study starts with the deficiencies recorded before and after the event. Through the hydrological simulation of the torrential episode from June 2018 with the Mike Hydro software, it became clear that the flow rate and velocity have insignificant influence on the status index gradient. On the other hand, these parameters prove to have a significant impact on certain damages and dysfunctionalities, which are indirectly reflected in the gradient variation.

Keywords

transversal hydrotechnical structures, damages and dysfunctionalities, hydrological simulation, torrential event, status index gradient.

Preservation of oak stands in the Republic of Croatia with an emphasis on biotic harmful factors, a Green Tax funded project

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Abstract

In the Republic of Croatia, pedunculate oak (*Quercus robur* L.) occupies large lowland areas and is one of the most important and economically valuable tree species. Lately, due to complex stand and ecological conditions, oak forest ecosystems are no longer as stable as they used to be. Impaired ecological conditions for oak growth caused by various abiotic and biotic factors such as air and water pollution and the lowering of the groundwater level lead to the physiological weakening of oak trees, which favors the appearance of primary and secondary pests (insects and fungi). All these pressures lead to the enhanced crown defoliation and dieback, absence of quality seed production, disturbed structural properties of stands, the absence of regular harvest (by dynamics, quality, and quantity), and difficulties in the restoration and development of these stands.

The research of this complex issue requires a complex approach, and the work on this project is based on the synthesis of the results of the work of several research groups working in three Croatian forest research institutions, while the project as a whole is led by Croatian Forest Research Institute. The work packages are as follows: Harmful biotic and abiotic factors in oak forests, Characterization of habitats and climate change, Genetic diversity and preservation of the oak gene pool in Croatia, Vitality of oak and stress indicators, and Adaptive forest management. The project is aimed at determining the extent to which the ecological and habitat conditions of these lowland stands are damaged and proposing scientifically based and ecologically acceptable measures for the restoration of oak stands.

Keywords

Pedunculate oak (Quercus robur L.); biotic and abiotic stress factors; climate change; preservation of oak gene pool; oak vitality; adaptive management.

The specificity of some wood physical properties in tending forestry work carried out in Norway spruce stands

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Abstract

This study analyses the specificity of some wood physical properties of the standing-trees (wood density and wood resistance to micro-drilling) in tending forestry work carried out in Norway spruce stands. The research material comes from 4 experimental plots where were applied different tending forestry work variants (control, moderate, strong) in the northern Carpathian Mountains. Data used consists of 270 standing-trees (78 trees - control variant, 85 trees - moderate variant, and 107 trees - strong variant). The research objectives were to: (1) highlight wood density particularities, (2) identify wood resistance to micro-drilling particularities, and (3) assess standing-tree wood density by micro-drilling. Average density recorded values of 0.357 ± 0.021 and 0.386 ± 0.027 g·cm^{-3} (for the control variant), to 0.364 ± 0.020 and 0.397 ± 0.027 g·cm^{-3} (the strong variant). Average micro-drilling resistance values were between 16.6 ± 2.6 and 22.5 ± 3.0% (for the control variant) to 19.7 ± 2.6 and 20.5 ± 1.5%. Linear regression models and generalized linear models were used to examine the relationships between wood density, biometric characteristics and amplitude of micro-drilling resistance. The linear regression results showed that micro-drilling resistance increased as wood density increased. Additionally, generalized linear models (GLM) showed that, when using covariates of microdrill resistance and tree diameter at breast height (DBH), there was a significant influence on the dependent variable, wood density, for all considered work variants. These results suggest that it is possible to consistently estimate both quality and resistance in Norway spruce standing trees using micro-drilling. Our findings suggest that wood density and micro-drilling resistance are dependent on biometric and qualitative characteristics, as well as the amount of tending forestry work conducted on Norway spruce stands.

Keywords

Norway spruce; wood density; micro-drilling; models.

Types of hydrotechnical works and methods of their arrangement in order to reduce torrentiality in small hydrographic basins in the Vrancea Subcarpathian area

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Abstract

The torrent control structures aim to reduce the risk of flooding in order to protect people, infrastructure, and socio-economic objectives located in risk areas, as well as protect the environment and biodiversity through relevant ecological measures. In the present work, the main types of torrent control structures, their location, and characteristics are presented in the Fetig watershed located in Subcarpathians Mountains (left tributary of the Milcov River), Vrancea County. High torrential phenomena characterize the study area, and in this respect, torrent control structures have been built in 2 stages covering a 1.6 km stream length. The structures have consisted of 22 transversal works o with the role of consolidating the slopes and retaining sediments. A longitudinal work for river bank consolidation consisting of a 30 m-long gabion was also executed. The useful height of the works is from 0 to 5.0 m, and from a constructive point of view, the works were executed from stone masonry. As a result of repeated flash floods, the deepening of the bed, and the massive transport of sediments, the structures have suffered some damage, so that they require intervention with repair works. In order to prevent the balance of the slopes from being disturbed, with the risk of landslides, river bank erosion, etc., which will primarily affect the interruption of access to the Fetig watershed for the residents of this village, as well as to prevent the degradation of the agricultural and forestry fund it is necessary to return with new torrent control structures that will contribute to restoring the hydrological balance in the watershed by stabilizing the lands that are sources of sediment, strengthening the banks and the sliding slopes. By directing flood flows along convenient routes and strengthening the base level of the bed, the proposed works ensure the protection of forest roads and contribute to ensuring the accessibility of the forest fund in the basin. The 13 newly designed torrent control structures will lead to approximately 3 km of riverbed consolidation, flash flood mitigation, silt retention, and the securing of existing structures. For the proper functioning of the torrent control structure system, it is necessary to continuously monitor its condition and intercede with repair or maintenance works, especially after the occurrence of exceptional flash floods that can affect the functionality and condition of the structures and the watershed hydrological balance.

Keywords

flash flood, watershed, torrent control structures, river bad, transversal works

Use of RGB and multispectral UAV system for the assessment of *Lymantria dispar* defoliation (a case study)

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Abstract

The implementation of a new technology on a large scale brings to attention a series of challenges that have been limited or insufficiently studied, often related to the specific nature of the application domain. Advancements in drone technology offer opportunities for the forestry sector, presenting approaches for conducting observations and precise measurements. This paper investigates the potential of UAV (drone) system in forestry, focusing on generation of photogrammetric products to meet current needs and practice. The use of multirotor RTK drone equipped with integrated RGB and multispectral sensors for assessing defoliation caused by insects, remains a relatively unexplored approach in forest protection specific field. Therefore, the flights performed and the results obtained can serve as a reference in advancing the development of such applications. The study area comprises stands of Turkey oak (Quercus pedunculiflora) situated in the forest-steppe region which is typical for the southern Romania, commonly referred to as "Ciornuleasa Forest". To gather comprehensive data, the flights were conducted using both an RGB camera and multispectral sensors (R-red, G-green, RE-red edge, NIR-near infrared), with precise spatial data correction accomplished through RTK technology.The flight mission considered specific information about the observed area, the forest stands selected within the study boundaries, the technical equipment used, and the specific parameters selected for the capture of the images, their pre-processing, and the generation of photogrammetric products.

The results were obtained using Structure from Motion software Pix4D mapper alongside other specific GIS tools. The deliverable products consist of RGB and multispectral orthoimages and specific images with distribution of Normalized Difference Vegetation Index (NDVI) values.

The processed UAV images allowed the identification of a significant outbreak of insect pests, such as the defoliator Lymantria dispar (gypsy moth). This outbreak manifested through varying degrees of tree defoliation. Using the derived multispectral indices, the assessment and quantification of the affected area were performed. The results of the study highlight that the use of drones in the forestry field allows the assessment of the impact of biotic factors on forest health status. Additionally, practical recommendations have been formulated, and directions for further research in this field have been indicated.

Keywords

UAV system; orthoimages; NDVI; insect pests; forestry.

Enhancing forestry practices by leveraging Sentinel-2 satellite imagery for windfall detection

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Abstract

The study proposes a method for detecting changes in forest vegetation over time using Sentinel 2 multi-temporal images. The chosen area selected to demonstrate the detection method's effectiveness in identifying changes caused by wind events, is located north of the Stâna de Vale resort in the Apuseni Mountains. In this area, a strong storm occurred on September 11, 2017, resulting in windthrows in several sections of the administrative unit. To detect the affected areas and estimate the volume of fallen material, two Sentinel 2 satellite images were utilized—one captured on July 31, 2017, and the other on August 30, 2018. The method employed for change detection involved calculating the arithmetic difference between corresponding spectral bands in the two images. Upon examining various band combinations, it was determined that the best results were obtained using the difference between bands 3 (green) of the two images. The reduction in land cover, particularly the presence of tree species like spruce, increases overall land reflectivity in the visible spectrum, followed by a decrease in near-infrared reflectivity. Initially, after the event, when the foliage is still alive, the reflectivity difference is less pronounced. However, as time progresses, the dried leaf canopy alters the spectral reflectance, while the understory vegetation gradually contributes more to the overall reflectivity, including in the near-infrared range. Consequently, areas where forest vegetation has disappeared, giving way to sub-arboreal vegetation, exhibit higher difference values compared to unchanged areas. The outcome of the analysis is a raster map highlighting the detected changes. Not all changes are necessarily caused by windfall events, so a progressive density slicing technique was employed to determine the precise extent of the affected area. A transition from raster to vector representation mode was necessary to facilitate geospatial analysis within a GIS environment, so the identified areas affected by windfalls were converted from raster to vector format. Quantitative assessment of the wind damage and evaluation of the affected surfaces were performed using geospatial analysis techniques. Specifically, the polygon layer representing the affected areas was intersected with the forest stand layer (UA) from the geospatial base of UP II Stâna. The spruce is the primary tree species affected in all areas by windfall damage, with a total affected area of 49 hectares.

The proposed method for detecting windfall effects allows a rapid assessment of these effects within a specific area, utilizing existing data in the geospatial database. Additionally, the application of progressive density slicing proved to be a fast and reliable technique, suitable for similar situations. Geospatial analysis, initially conducted in raster format and then converted to vector format, enables the evaluation of fallen surfaces. This evalposeruation's results can be presented in the form of maps and as quantitative data. The method for detecting windfall effects is relatively fast and straightforward to implement, the only limitation being the availability I short time of good quality satellite imagery.

Keywords

windthrows detection; disaster impact; quantitative assessment; geospatial analysis; remote sensing.

A Study on the Development of an UAV as a Solution to Fight Illegal Deforestation

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Abstract

The paper presents the research conducted regarding the development of an innovative unmanned aerial-vehicle (UAV) that has a specific mission, to register the acoustic signature emitted by chainsaws and to identify and communicate the location of the deforestation in order to evaluate its legality. The experimental model consists in a fixed-wing UAV featuring a vertical take-off/landing system (VTOL) with a tri-rotor propulsion system configuration. For this UAV model an autopilot was developed along with an acoustic system governed by an AI (artificial intelligence). The onboard processing computer houses the AI program developed and trained to recognize the specific chainsaw noise profiles and allows the identification of the sound source's location. A link was created between the autopilot system and the acoustic system that ensure the autonomous guiding of the UAV towards the sound source in order to assess the legality of deforestation. The experimental model designed is considered a step forward in the illegal deforestation and logging combat.

Keywords

deforestation, UAV, AI, chainsaw, global warming

Agro-ecological management strategies to improve climate change mitigation in organic fruit orchard in Italy.

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Abstract

Adoption of agro-ecological soil management strategies in different agricultural and forestry systems can modify their capacity to mitigate the negative effects of climate change. Thus, monitoring the trade-off between soil carbon (C) sequestration and greenhouse gasses (GHGs) emissions (CO_2, CH_4, and N_2O) in long-term trials is crucial to assess the long-term responses of these strategies on different fruit orchard and agroforestry systems. Within EJP SOIL – SOMMIT project, a long-term fruit orchard (*Prunus armeniaca* L.) trial was selected in a Mediterranean North climate to assess the effects of three different agro-ecological soil management strategies on soil C sequestration, GHG emissions, and nitrate leaching. The long-term trial was setup in Rome (Lazio Region, Italy) in 2017. Since autumn 2021, fluxes of CO_2, CH_4 and N_2O, have been measured together with weather parameters, and inorganic N availability. Soil organic carbon dynamic was compared with C accumulated in the past years. The objectives of the monitoring were to assess the impact of different fruit orchard management in terms of tillage, inter-row cover and amendment choice on the trade-offs between long-term C accumulation and GHGs emissions. Moreover, the work aimed at improving the understanding of the main abiotic and biotic drivers of GHGs exchanges considering the plant-soil-atmosphere integrated system. The first year of measurements showed high N_2O emissions in typical organic management, in the two months following the fertilizer distribution. Innovative inter-row managements with agro-ecological service crops or natural soil cover combined with urban compost distribution showed the same timing in N_2O emissions but lower fluxes. All treatments showed similar CO_2 emissions following the same dynamic during the year. All the three fruit orchard systems, independent of inter-row management and type of fertilizer, acted as sinks for CH_4.

Keywords

Agroforestry, Fruit orchards, C sequestration, N_2O emissions, CH_4 uptake

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