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Editorial: Old-growth forests of southeast Europe and their relevance for forest management

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Editorial on the Research Topic
Old-growth forests of southeast Europe and their relevance for forest management

Research of spontaneously and naturally developed forest ecosystems without human influence allows us to gain new knowledge that can be useful for adaptive, close to nature management of commercial forests. Global changes such as climate warming, the emergence of invasive diseases and pests in forests threaten the ecological function, biodiversity and services of forest ecosystems (Chidawanyika et al., 2024).

Many threatening factors have created the need to extract new old growth forests areas, map and define ways of managing old-growth forests as the best natural laboratories for acquiring new empirical knowledge for application in commercial forests. Knowing these needs, the new EU strategy for European forests until 2030 aims to preserve, protect and increase the area of old-growth forests. The realization of this strategic goal is of great importance, especially in Central and southeastern Europe due to the fragmentation of the areas and the specific composition of deciduous (*Fagus sylvatica, Acer pseudoplatanus, Fraxinus excelsior*) and coniferous (*Picea abies* and *Abies alba*) species that make up these old-growth forests.

The risks and uncertainties that forest ecosystems are facing highlight the need for comparative research structural characteristics, dynamics of development and vitality between European oldgrowth forests and commercial forests. Motta, Garbarino, et al. indicate differences in terms of structural diversity, especially in the quantity and quality of dead wood. These changes occur as a consequence of different protection regimes and the intensity of endogenous and exogenous processes. The old forests of southeastern Europe are characterized by large trees and successful natural regeneration. The upper age limit of the trees of the main types of trees (beech, fir and spruce) is often more than 400 years old. This contributes to a very long silvigenetic cycle of initial, optimal and terminal development phases lasting over 450 years (Mlinšek, 1968). The sudden cessation of cultivation measures with the aim of forest conservation can have a negative impacts on natural processes and biodiversity. Strict protection regimes can cause the loss of a unique cultural landscape in old-growth forests, and traditional management based on a selection system has enabled the preservation of bio-cultural diversity.

The old forests of southeast Europe differ from each other according to structural indicators, and this difference is especially pronounced in relation to commercial forests (Bončina, 2000; Govedar et al., 2018). Also, the biodiversity of old forests is lower compared to commercial forests (Keren and Diaci, 2018).

Although beech is the most widespread tree species in Europe (Leuschner, 2020), the areas of old growth forests are relatively small. Kanjevac et al. point out that the natural regeneration of beech represents one of the most important processes in the temporal dynamics of the development of its old-growth forests. In order to preserve the complex dynamics of natural regeneration of forest ecosystems, modern commercial forest management concepts rely on treatments that mimic natural processes in old-growth forests and thus affect the preservation of biodiversity, stability and functionality of forest ecosystems. The phenotypic plasticity and evolutionary adaptability of European beech may prevent further declines in European beech distribution resulting from climate change in the future (Bolte et al., 2007). Beech in old-growth forests with fir and spruce in the middle and upper story has an inferior biosocial position, however it can be the dominant species in the understory. Regulating the composition of stands is a key factor affecting structural heterogeneity and species diversity in beech forests (Massad et al., 2019). As a result of the death of old trees, openings are created inside stands, and suppressed beech seedlings get space for strong growth. These seedlings have an advantage over newly established young plants because they have a developed root system and pronounced heliotropic properties (Feldmann et al., 2020; Petrovska et al., 2023).

As a consequence of different forest management systems, there are differences in the numerical values of vegetation indices (Modzelewska et al., 2020), which is particularly reflected in the differences between old-growth forests and commercial forests (Spracklen and Spracklen, 2019). Also, different types of trees in optimal physiological activity have different values of vegetation indices (Pu, 2021; Zhong et al., 2024). Differences in vegetation indices arise as a result of different vitality and representation of assimilation organs on trees (Xue and Su, 2017). Govedar and Anikić indicate that the developmental stages of the old-growth forests (initial, optimal and terminal) are characterized by specific structural features. The different health conditions of the trees, and these features are reflected in the numerical values of vegetation indices, which enables monitoring of the spatial dynamics of changes in the development stages. Differences in the values of vegetation indices may be the result of differences in species, density of vegetation, ecological conditions and the influence of atmospheric factors.

Motta, Alberti, et al. they determined that the long-term dynamics of tree mortality in the old-growth forests of southeastern Europe indicate that there were no organized human activities. Such old-growth forests can serve as a reliable reference for biodiversity (Parisi, 2024) and a benchmark for the carbon sink, i.e. quantifying the impact of climate change on forests (Palandrani et al., 2021). As the age of the forest increases and the number of large trees increases, carbon sequestration increases (Gray, 2015). The old-growth forests of the Dinarides have great ecological and socioeconomic importance because they provide various ecosystem goods and services (Hilmers et al., 2019), with a constant increase in scientific research. The dynamics of natural regeneration in them depends on natural disturbances that occur as a result of the death of trees, the influence of strong winds, the gradation of insects and phytopathological diseases of trees (Nagel et al., 2017). As a result, in the old-growth forests, openings are created within the stands that affect the microclimatic conditions, especially the regime of light and heat (Nagel and Svoboda, 2008; Bottero et al., 2011).

Although there are very few forests in Europe that correspond to strict old growth forests parameters (O'Brien et al., 2021), it is necessary to use broader definitions for old-growth forests in order to distinguish new areas that have been outside the influence of man for several decades, such as the old forests of the Dinarides. Although it is not possible to have old-growth forests in all types of European forests, they need to be protected because of their scientific and irreplaceable conservation value.

Author contributions

ZG: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. SV: Conceptualization, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. NV: Conceptualization, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

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