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Editorial: Forest species and stands regeneration

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Editorial on the Research Topic
Forest species and stands regeneration

Forests are essential for maintaining the balance of the Earth's ecosystem, regulating climate, providing clean air and water, and supporting biodiversity. SDG15, also known as the "Life on Land" goal, aims to protect, restore and promote the sustainable use of terrestrial ecosystems, including forests, to ensure their inherently valuable characteristics and the provision of ecosystem services. The regeneration of forests is fundamental to achieving this goal.

Studying regeneration patterns, factors fostering regeneration, and those constraining it is fundamental to understanding the dynamics at the early stages of forest development and supporting adaptive management measures.

Up-to-date knowledge of the crown cover (percent of the horizontal crown projection in relation to a ground area) is essential, with periodic monitoring and assessments to identify species composition, damages and losses or to control afforestation and deforestation changes or succession dynamics. These assessments aim to be increasingly expeditious but still guarantee high classification accuracy. Melnyk et al. investigate the combination of open geographic information systems and remote sensing data and describe in this special issue methods of unsupervised and supervised classification to map forest species using as a case study of Volyn region in Ukraine. The use of Machine Learning algorithms for classification is recognized. It will get increasingly more accurate results with the high spatial resolution of current open remote sensing data and developments in Data Science.

Forest regeneration can be achieved through various methods, including natural regeneration, assisted natural regeneration, and plantation. Natural regeneration involves allowing forests to regrow naturally from seeds or sprouts, while assisted natural regeneration and artificial involves using management practices (e.g., seeding to facilitate regeneration and seedling planting) to ensure the maintenance, the restoration of forests that have been lost or degraded or the creation of new forests through afforestation. Gonçalves and Fonseca comprehensively review methods to regenerate high forest stands and analyze the management factors and disturbances that favor or constrain the regeneration process.

Promoting the regeneration process requires knowledge of the appropriate silvicultural systems (*e.g.*, clear-cut, shelterwood and selection) or the harvest practices for a given species or group of species. Effective choices adequate to the species' traits are required to promote

natural regeneration success. Crucial factors affecting the regeneration and growth of the forest species are soil and water resources and availability of light, the degree of which depends on the species tolerance to shadow. Original research on the effect of gap-based silvicultural systems on tree regeneration is presented by Schnake et al.. The authors highlight the importance of *a priori* considering gap size, structure and composition of the forests, site quality and harvest criteria when implementing group selection harvesting to emulate canopy gap formation following disturbances.

Evaluation of the quantity and quality of the seedlings/saplings is vital to ensure the forests' sustainability. Although the former is a traditionally adopted methodology based on the number of live and dead individuals, studies involving characteristics for assessing plant viability have been less common in field monitoring. Gouveia-Barrocas and Gonçalves present original research on methodology to assess the quality traits of natural regeneration for holm oak. The authors propose a classification method, expressed as an index, that considers the influence of the upper story, the degree of crown isolation, the tree habit, and the individuals' height and diameter sizes. The index details the potential for recruiting individuals with desired traits to the main stand. It allows the identification of specific silvicultural practices' needs, such as pruning and thinning. The authors suggest the enlargement of the index to other forest inventories of saplings in naturally regenerated stands.

Studying forest regeneration dynamics is fundamental to understanding the early stages of stand development. The factors associated with regeneration, such as planned management interventions, abiotic (fires, storms, climate change) and biotic (pests and diseases), play a key role in its success. Therefore, knowledge of the process and its monitoring is essential to maintaining (or promoting) the forest's sustainability and production and conceiving appropriate adaptive management actions, which helps ensure successful forest development.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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