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Editorial

Expansion of Naturally Regenerated Forest

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Forests cover 31% of the global land area and are home to most of Earth's terrestrial biodiversity. Forests supply a wide set of ecosystem services, provide livelihoods, mitigate climate change, and are essential for sustainable food production, contributing to the health of the planet. However, deforestation and forest degradation continue to take place at alarming rates in some parts of the world, whereas in others the trend has been reversed with forests expanding over abandoned agricultural areas.

In this era of contrast, improving our knowledge of ecological processes and mechanisms involved in the natural regeneration and expansion of forests should be a priority. Factors affecting forest expansion are extensive, such as seed production and dispersal, seedlings establishment, shrubs species colonization, microsites availability, soil conditions, as well as the complex interactions that occur within and between all levels of forest biological diversity (e.g., local, ecosystem, landscape, species, population, and genetic) in the colonization process. Hence, substantial efforts are needed to integrate this knowledge in new management and implementation actions in these two contrasting scenarios: (i) to reverse deforestation and biodiversity loss for the benefit of current and future generations; and (ii) to manage expanding forest over agricultural areas to maximize the conservation value of these new forests and guarantee the ecosystem services they provide. Within this Special Issue, we collected contributions that target directly the effect of these factors, such as microsite availability, boundary effect, light conditions, soil properties, or shrub colonization to improve our understanding of constraints/un-constraints for natural forest expansion all around the world, while providing practical recommendations for the reforestation of degraded ecosystems.

The Special Issue starts with a manipulative experiment about seedling emergence of two contrasting co-occurring *Quercus* species under a bioclimatic limit, using shrubs as facilitators. Interestingly, the clear facilitative effect of shrubs on the seedling emergence of *Q. ilex* and *Q. pyrenaica* was demonstrated, this being a positive effect over emergence even greater than those caused by acorn size and large herbivore exclusion [1]. Similarly, a study describing the boundary form effect between two patches with contrasting vegetation (mine grassland and adjacent forest) on woody colonization (*Quercus* species) and forest expansion showed that the tree colonization decreased with increasing distance to the forest and differed depending on the boundary form, with more intense colonization in concave boundaries than in convex boundaries close to the forest [2]. Both manuscripts showed that shrub facilitative processes and edge characteristics have a strong potential to be used in the restoration of *Quercus* native forests based on natural processes.

The identification of the factors controlling the understory and main tree species distribution and seed dispersal are essential to understand natural forest dynamics. As such, some authors using forest inventory data reported the relationships between environmental gradients and shrub functional groups distribution patterns and niche characteristics as the first step to improve our ability to discuss potential forest conservation management goals or threats due to land-use changes and future climate change [3]. Regarding seeds, an experiment testing whether intraspecific variation of dispersal potential and the associated traits of seeds (*Acer palmatum* diaspores) should be influenced by maternal habitat quality showed that samaras produced by trees from shaded microhabitats had greater dispersal potential, in terms of slower terminal velocity of descent, than those produced in open microhabitats [4]. These findings indicate that an active maternal control through the morphological allometry of samaras is produced to facilitate species persistence. The main tree species dynamics are subjected to current climate change; therefore, integrated bio-geographic studies of pine forest might help to identify forest areas most susceptible to climate change effects. Here, the results showed that the more fragile and precipitation-poor upland pine settings display a higher vulnerability to the current climate change, resulting in increased tree death and forest fires [5]. These three main results suggest that the dispersal potential and shrubs as facilitative microhabitats could be factors to consider in forest expansion management plans. However, forest sustainability and adaptation to the ongoing climate change can trigger deforestation and forest degradation worldwide.

Finally, forest restoration has become one of the most important challenges for ecological restoration, although the post-disturbance recovery of plant–soil feedback has been rarely assessed or described. Aboveground–belowground interactions between trees and fungi are fundamental in nutrients and carbon cycles [6]. Here, biomass and structure of fungal communities were compared between *P. sylvestris*, *Q. robur* and *Q. ilex* (holm oak) forests and naturally revegetated mined sites to identify similarities in soil/litter inoculum between habitats to enhance tree seedlings' establishment success in degraded areas [6]. These results showed that tree restoration strategies in degraded sites could use specific soil/litter inoculum from similar nearby forest areas upon planting/seeding, depending on tree species of interest, to provide a satisfactory soil fungal community over which to start the functional optimization between fungi and tree species dependent on the plant resources needed.

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