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Editorial: Vital rates of forest dynamics driven by traits and performance of trees

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Editorial on the Research Topic

Vital rates of forest dynamics driven by traits and performance of trees

Global change is influencing plant growth and ecosystem productivity. This is a main challenge for forest ecology, aiming at understanding the dynamics of tree communities (Canadell and Raupach, 2008; Gottfried et al., 2012; Anderegg et al., 2015; Gazol et al., 2018). Modeling forest dynamics for different climate changes scenarios is substantially gaining interest, given the key role of forest ecosystem services such as carbon offsetting (Dixon et al., 1994; Favorskaya and Jain, 2017). Climate driven changes of structure and floristic composition of a vegetation are resulting from alterations in vital rates of mutually interfering populations. Vital rates depend on performance of individual trees (Westoby et al., 2002; Beeckman, 2016; De Micco et al., 2019). A wide spectrum of functional traits, including foliar, wood, tree architectural and phenological characteristics, shapes tree performance. Traits are impacted by environmental shifts, including rising temperatures, higher frequency of heat waves and forest fires, more severe and prolonged drought events, changing periodicity of rainfall, rising CO₂ concentrations and insect outbreaks (Kautz et al., 2017; Masson-Delmotte et al., 2018; Ogaya et al., 2019).

Traits are input variables for some of the models that support the international policy on climate change. Relationships between traits, tree performance and forest structure are typically complex. A good understanding of trade-offs between traits, vital rates and community assemblies depends on solid data, collected at multiscale levels, involving multidisciplinary methodology (De Micco et al., 2019). The principal vital rates (i.e., regeneration/recruitment, individual growth, and survival/mortality) can be studied in isolation, but interactions can have distinctive effects on populations.

Studying global trends typically simplifies the underlying drivers. This requires selecting plant traits, that are representative and show robust correlations with relevant eco-physiological processes (Suding et al., 2008). Global models also use mean values of species traits, assuming a larger interspecific than intraspecific variation (Shipley et al., 2016), which might not be the case locally.

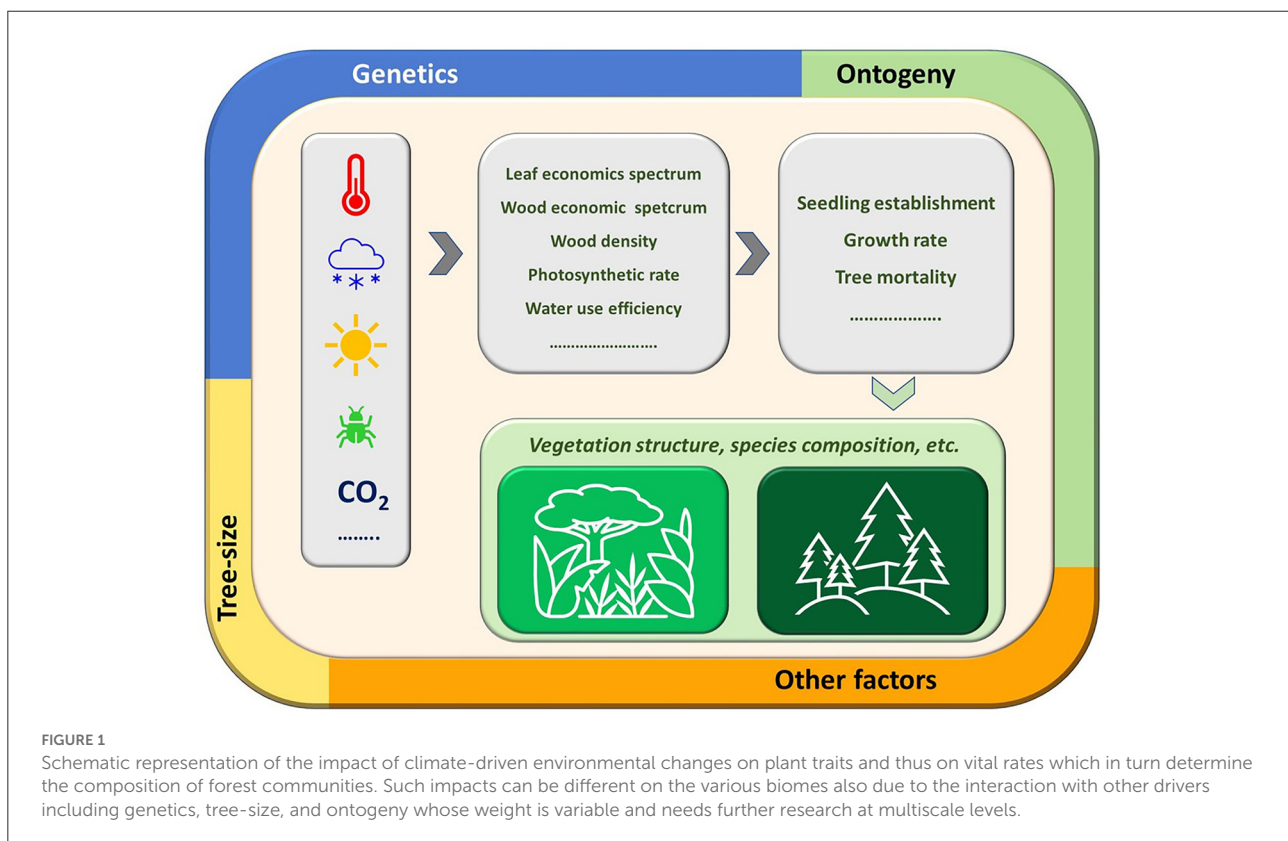
Hecking et al. addressed the issue of robustness of trait covariation, which can be much weaker on a smaller spatio-temporal range than at global scale. They studied trait variation in different life stages of individuals along an environmental gradient, covering temperate and montane boreal forest in northeast United States. They checked for species crossover, where the ranking of trait values changes along an environmental gradient. The authors analyzed the degree of covariation and the intraspecific trait variation in nine functional traits in overstory and understory. They highlighted that the relative importance of intraspecific trait variation is trait-specific, but globally relevant trends were still significant at local scale.

Especially for long-standing species, an often neglected source of variability is due to plant size and ontogeny. Tree size is the result of both primary and secondary growth that substantially influence the trait spectrum resulting in distinct age- or size-trends. The challenge of disentangling ontogeny and environment has been faced by Corrêa Scalón et al. who modeled growth trajectories of 45 woody species from a regenerating subtropical forest in the Brazilian Atlantic biome. Discrete grouping of growth patterns or plant traits was not detected. The authors suggested a gradual distribution of the analyzed species between two extremes defined by architecture, leaf dry matter content and growth rate dynamics. They recognized the complex

nature of growth trajectories that contribute to the intrinsic diversity of the tropical forest system.

Another challenge is disentangling environmental and ontogenetic drivers from genetic effects (Housset et al., 2021). Tree populations with high genetic diversity are assumed to be more resilient, showing a stronger regrowth after disturbance (Reed and Frankham, 2003). However, unequivocal relations between tree growth and genetic diversity have not been found yet, likely because of interferences with age- and size trends. Venegas-González et al. conducted a study on five isolated populations of *Nothofagus macrocarpa* to evaluate the contribution of genetic variability, biogeography, and tree size on the growth resilience after an extreme drought in the only Mediterranean forest in central Chile. Tree-ring data and nuclear microsatellite markers confirmed that the resilience of *N. macrocarpa* could be better explained by site and tree size than genetic diversity. Nevertheless, they underlined that a whole-genome analysis might identify genomic regions correlated to the phenotype, including certain traits influencing adaptive patterns.

Dendroecology usually doesn't consider the genetic diversity within populations, assuming a stronger environmental effect on tree plasticity than genetics (King et al., 2013). Since long-lasting plants offer opportunities to construct time series based on pith-to-bark profiles of wood traits such as density, vessel features



and other anatomical characteristics, a dendrochronological dimension to the topic of traits and vital rates is appealing. An often used trait is leaf phenology which is closely linked to the cambial activity and contributes to the formation of tree-ring series. Asynchronous growth patterns among trees can be interpreted in terms of resilience capacity of a population (Fritts, 2001). A study of *Prioria balsamifera* in the Mayombe rainforest in western Congo led Angoboy Ilondea et al. to conclude that, despite a distinct periodicity of leaf phenology, crossdating of tree-ring series was weak. This confirms that populations of tropical rainforest trees developed a bet hedging strategy making them resilient against climatic changes.

Climate change also increased incidence and severity of insects outbreaks resulting into tree damage and eventually tree death. Finding early signals for significant tree stress after defoliation remains a challenge. Effects on plant water relations and tree growth can be positive or negative with unclear underlying mechanisms. Studying *Picea mariana* and *Abies balsamea*, defoliated by eastern spruce budworm, Balducci et al. confirmed that monitoring stem radius variation (e.g., duration and amplitude of expansion/contraction) can be useful to detect early signals of stress caused by mild defoliation.

Taken together, the contributions to this Research Topic covered some key aspects of the multiple relations between traits and forest dynamics (Figure 1). While the relationship between tree performance, vital rates of populations and composition of forest communities is unmistakable in general, empirical evidence is still needed for better predictions of

population dynamics and forest tree species assemblies. Data-supported clarifications on which traits influence which vital rates are needed at multiple scales given the numerous sources of variability.

Author contributions

VD and HB conceived and designed the Speciality Section, wrote, revised, and approved the submitted version of the manuscript. Both authors contributed to the article and approved the submitted version.

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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