Editorial: Plant Competition in a Changing World

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Editorial on the Research Topic

Plant Competition in a Changing World

Climate change and biological invasions place new challenges on plants, their development, fitness, and competitiveness. To develop and evaluate strategies for sustainable ecosystem management and to respond to biodiversity loss, we need mechanistic understanding of the changes that are occurring in plant communities. Underlying drivers of change are plant–plant interactions which include competition, facilitation, and avoidance of competition, and their regulation by environmental factors (Trinder et al., 2013). The studies highlighted in this book examine plant competition in range of communities that span from forests to meadow and crop systems across alpine, temperate, and tropical climates.

Facilitation, positive interactions between plant species, is a key driver of plant community dynamics and structure, but comparatively few studies have examined how facilitation is modulated in response to climate change (Brooker, 2006; Brooker et al., 2007; Lavergne et al., 2010). In their review, Anthelme et al. discuss four aspects of facilitative effects in alpine systems in response to climate change: (1) a reduction of facilitative effects in alpine plant presence in response to declining cold-temperature stress due to warming in established alpine systems, (2) an increase in facilitative effects as a response to migration to colder environments with higher elevation, (3) changing patterns of facilitation along latitudinal gradients, and (4) the potential of nurse plants to buffer changes in microhabitats. Anthelme et al. present different migration scenarios that include various types of facilitation in response to increasing temperature. Valladares et al. review the consequences of facilitation and competition in context of global change, encompassing climate change, and biological invasions, with a focus on phylogenetic relatedness, functional traits, and phenotypic plasticity. Valladares et al. summarize the direct and indirect drivers of species richness in different ecosystems, such as temperate and tropical forests, grasslands, and alpine systems. The authors argue that studying pauci-specific communities will provide the necessary understanding on species interactions in more complex systems. The reviews by Valladares et al. and Anthelme et al. conclude that although there is no doubt that climate change impacts on plant communities directly (e.g., via increasing temperatures) and indirectly (e.g., via changes in the interactions between species), further empirical knowledge is needed to advance understanding of the underlying mechanisms of plant–plant interactions in different plant communities, climate, and resource settings. For example, studies on alpine systems are biased toward certain regions, especially Europe, with other regions overlooked. The authors recommend examining systems in which single species and their intra-specific functional variability are important to expand from the current focus on species-rich systems such as tropical rainforests.
The other key driver discussed here is competition, especially in resource-poor habitats where plant growth and reproduction is challenging and/or further impaired with global change. A plant’s ability to occupy space influences its ability to access resources such as light, water, and nutrients. Studying the relative influence of topography, environment, and spatial distance of rockcress (Boechera stricta) to other individuals, either intra- or inter-specific, Naiithani et al. found that this species’ performance in a meadow community is predominantly influenced by intra-specific competition and insect herbivory. In contrast, its spatial distribution in the meadow community is limited by dispersal and microhabitat preference. At the other end of the plant size spectrum and focusing on competition for light, van Kuij et al. present a 3D-model, validated with field data, for calculating photosynthesis rates for individual trees in forests. Such model has potential to assist forest management strategies, such as aiding the potential effect of accelerated succession to generate resilient forests/plantations.

Prior and Bowman investigated the interaction between tree growth and microhabitat across a macro-ecological gradient. They present new evidence from an extensive dataset of eucalypt tree growth collected across temperate and sub-tropical mesic Australia that in cooler habitats with sufficient water availability, light is the most limiting resource which results in increased competition, whereas in hot and dry habitats where water is the limiting factor, light is no longer driving competition. The study by Muller et al. on species interactions in urban plantings at three buildings in subtropical Australia, expands on the relationships of light and water, and demonstrates that plant productivity and arthropod diversity increase in situations with abundant availability of resources. This study provides evidence that ecological principles are transferrable from natural systems to human-made urban systems. Expanding on plant–plant competition from light and water, the study by Li et al. examines nitrogen as a main macronutrient that limits plant growth in many plant communities, and demonstrate that competition is reduced in two co-occurring tree species, beech and sycamore maple, that have a preference for organic and inorganic nitrogen forms, respectively. Another mechanism to avoid competition is allelopathy, the release of plant-growth inhibiting or toxic substances into the rhizosphere. Asaduzzaman et al. identified potentially allelopathic compounds in a laboratory bioassay investigating root and shoot tissue of different canola cultivars when growing in competition with weeds. The authors suggest that an allelopathic effect depends not only on the synthesis of certain compounds, but also on their active exudation into the rhizosphere and this seems to be dependent on intrinsic genotypic factors.


References: Simon and Schmidt: Plant Competition in a Changing World

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