Ecological processes shaping community dynamics in seasonally dry tropical forests: lessons learned from a restoration program on Réunion island

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Abstract

Understanding how ecological processes control community asssembly during secondary succession remains one of the greatest challenge in ecology. In a global context of habitat degradation and climate change, restoration ecology provides opportunities to both test ecological theories and optimize restoration actions. Although well documented in tropical wet forests, the importance of environmental filtering and biotic interactions in community assembly are less known in seasonally dry tropical forests (SDTF), yet among the most threatened ecosystems worldwide, particularly on densely populated islands. Here, we study the population dynamics of early life-stages trees in a restoration program of SDTF on Réunion island that includes afforestating 9 ha of secondary savannah. We specifically aim at understanding the effects of abiotic filters, in relation with climatic constraints, and biotic processes such as competition and facilitation on individual performance. We investigate the survival and growth of 6292 individuals in 45 species between 2012 and 2017 in various conditions of planting density. In each survey plot, abiotic descriptors, such as slope, elevation and rainfall, were recorded. Species composition and intra-plot cover were monitored between 2012 and 2017. Our results show that environmental changes during the first year after planting have a strong impact on the survival of seedlings and on their relative growth. In particular, rainfall amount, especially during the dry season, act as a major determinant of seedlings survival, shifting species composition in plots. Globally, fast-growing species experiment a higher mortality than slow-growing species at all censuses. Although stems density seems to positively impact mortality through time, shadowing provided by fast-growing species increase overall survival even at early-stages. Those results highlight how restoration can improve, not only future restoration works, but also theories in community ecology. As expected, environmental filtering, especially water-availibilty, drive communities dynamic in SDTF. Furthermore, early intra-community effects of competition and facilitation appeared to act as strongly on species survival and growth. At local and regional scale, this study provides tools for SDTF restoration to potentially optimize survival, growth and eventually the assembly of native plant communities.

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