Pre-dispersal seed predation and reproductive strategy affect genetic diversity in expanding tree populations

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Ecological and evolutionary processes involved in population expansions are key drivers of the ability of organisms to colonize and persist in novel territories. Long-lived sessile organisms such as trees may be more exposed species facing such colonization and adaptation issues. The environmental factors affecting both reproductive and dispersal capacities, and more specifically biotic interactions, are acknowledged to have a strong influence on expansion success, but their demo-genetic implications in expanding tree populations remain an understudied body of theory. Here, we contribute towards filling this gap using a theoretical approach based on a mathematical model, to describe the impact of pre-dispersal seed predators on the spatio-temporal evolution of genetic structure within tree expanding populations displaying highly variable (masting species) or consistent (non-masting species) interannual seed production. Our theory shows that pre-dispersal seed predation induces an Allee effect at the front of expansion that enables the maintenance of a higher tree genetic diversity, as compared to a situation where the seed predators are absent. Interestingly, masting tends to buffer such seed predation-induced Allee effect, which results in lower overall genetic diversity in the expanding population than in the non-masting population. Furthermore, simulations also shows that these demo-genetic consequences of seed predation are enhanced by fat-tailed distributions of seed dispersal. This theoretical approach provides novel insights on the effects of biotic interactions on tree population dynamics, calling specifically for more consideration of their demo-genetic implications in mechanistic and process-based approaches of expanding populations in broader contexts.