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The role of age-structured propagule pressure and human-mediated dispersal in determining plant invasion dynamics

Biological invasions play a major role in the current erosion of biodiversity and are costly for our societies. These problems are expected to grow in the coming years with the increasing accumulation of invasions around the world. Preventing invasions at minimal cost requires good timing, in particular for trees, whose exponential growth is often preceded by a lag phase, creating a crucial opportunity for management. However, the underlying mechanisms and duration of this lag phase are still poorly understood. We ask to what extent tree invasion lag phases are explained by age structured fecundity and human-mediated long distance dispersal. We propose a Bayesian hierarchical model that reconstructs mechanistically the spatial dynamics of trees based on their spatio-temporal occurrences. The proposed model accounts for known introduction locations and jointly estimates the environmental niche, the age structured fecundity curve and the effect of urbanization level on long distance dispersal rate by reconstructing age-structured populations across space and time. Capitalizing on past professional monitoring schemes and recent crowdsourcing data, we fit this model on past invasions over the last forty years in South Africa and Mediterranean Europe. We synthesize for each species the fecundity curve profile, and analyze the relationship between population age structure and global propagule pressure along with the contribution of urbanized areas as propagule sources for establishment in the wild.