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Functional and phylogenetic temporal turnover in two temperate forests in Northeast China

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Abstract

Whether deterministic or stochastic processes dominate temporal turnover of community composition and which factor has significant influence on that turnover, has been a central challenge in community ecology. Functional and phylogenetic temporal beta diversity can capture important insights of the underlying processes. In this study, we focus on functional temporal turnover based on 14 functional traits and phylogenetic temporal turnover using fully mapped data in two large temperate forest plots at different successional stage. We found that 1) Deterministic processes are the main process for both forests and size classes. The functional and phylogenetic compositions are relatively constrained at late successional stage and changed dynamically at early successional stage.

In young-growth forest, useful and phylogenetic temporal changes were basically higher than expected for all trees, small trees, and large trees. Conversely, in the old-growth forest, useful and phylogenetic material changes were lower than expected for all trees, but opposite marking were found for two size classes; i.e., change was elevated than expected for large trees and lower than expected for small trees. BRT models showed that the most influential factors underlying the temporal change of all trees shifted from abiotic (e.g., topography) to biotic (e.g., basal area) factors with increasing succession phase. Regardless of successional phase, the suitable factors changed from abiotic factors for small trees to biotic factors for large trees.

The purpose of this study are to detect (1) the relative consequence of deterministic vs. stochastic process in driving the functional and phylogenetic material changes at different successional stages and tree size classes in temperate forests and (2) the relative effective of abiotic vs. biotic factors on temporal change.

Moreover, the functional and phylogenetic turnover of two size class trees have contrary tendency at different succession stage, which may be due to the similarities among death, recruitment and survival individuals. 2) Principal components and null model analysis showed that functional traits that are more related to “nutrient economy” and structure investment can significantly influence the temporal turnover; 3) Biotic factors (e.g.. basal area of neighborhood) play an important role in influencing functional and phylogenetic temporal turnover for both forest plot. In conclusion, our analysis clearly emphasizes the functional and phylogenetic temporal turnover are deterministic at local scale. In addition, identification of key functional traits are important for functional diversity analysis, which can contribute to a better understanding of local community assembly mechanisms.

Temporary change in community composition outcome from a combination of immigration and local demographic dynamics . The dynamics depend on stochastic processes and on how survival and reproduction are over blown by environmental factors and biotic interactions over time Characterizing the temporal swap of community composition can thus give insights into fundamental assembly processes. Many studies in community ecology focus at inferring assembly processes from the spatial structure of communities at a given time , but they miss how configuration at a given time can influence subsequent dynamics, especially when biotic inter linkage are at play. Although space-for-time replacement considers different temporal stages of community dynamics allocated in space, it does not acknowledge how assembly depends on previous community states.

Deterministic procedures govern tree functional and phylogenetic material changes, and the underlying deterministic processes change from habitat filtering to biotic interaction over succession and with growing tree size.

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