

Development stage-dependent effects of biodiversity on aboveground biomass of temperate forests

Wen-Qiang Gao¹, Maowei Liang², Wenhua Xiang³, Liyoung Fu¹, Hong Guo¹, Xiao He¹, Ram P. Sharma⁴, Zhicheng Chen⁵, Yutang Li⁶, Mengli Zhou⁷, Jie Lan⁸, Dongli Gao⁹, and Xiangdong Lei¹

¹Institute of Forest Resource Information Techniques, Chinese Academy of Forestry

²University of Minnesota

³Central South University of Forestry and Technology

⁴Tribhuvan University

⁵Ecology and Nature Conservation Institute, Chinese Academy of Forestry

⁶Jilin Forestry Inventory and Planning Institute

⁷Hunan Agricultural University

⁸Beijing Forestry University

⁹Industry Development and Planning Institute, State Forestry and Grassland Administration

February 21, 2024

Abstract

Biodiversity–ecosystem functioning relationships (BEFs) have been extensively explored across ecosystems. However, these relationships may change as the forest matures, and the underlying mechanisms remain underexplored. Using large temperate forest datasets from 2,392 permanent plots in northeastern China, we examined the relationships between biodiversity and aboveground biomass (AGB) across different developmental stages from young to over-mature stands. We found the positive BEFs using both species richness and functional diversity, but these positive effects decreased with forest development. However, the effects of community-weighted mean on AGB showed two peaks in young and mature stands. Notably, the effects of community-weighted mean on AGB became larger than the effects of functional diversity after the forests developed to near-mature/mature stands, indicating that BEFs are driven by mass-ratio effects (i.e., dominant species) rather than niche complementarity in old stands. Our findings on how the developmental stage influences the effects of biodiversity on ecosystem functioning in natural forests will help identify effective strategies for maintaining or enhancing ecosystem services at different forest successional stages.