

Characterizing forest structural and functional diversity relationships across spatial scales and climate gradients in the eastern United States

Zachary Horve, Purdue University
(zhorve@purdue.edu); Songlin Fei, Purdue University;
Dennis Choi, Dankook University; Brady Hardiman,
Purdue University

Introduction: Understanding the functioning of forest ecosystems is critical to preserving biodiversity and ecosystem services forests provide. Vegetation structural diversity, which describes the complexity of composition and arrangement of vegetation, has been identified as a key driver of forest ecosystem functioning. Airborne light detection and ranging (LiDAR) has enabled broad-scale mapping of forest structural diversity, but questions remain regarding the role of how forest biodiversity influences different dimensions of forest structural diversity.

Objectives:

- Determine the spatial scales at which the strength of the relationships between structural and biodiversity are strongest.
- Evaluate how the shape of the biodiversity-structural diversity relationships change across spatial scales.
- Evaluate how the strength and shape of biodiversity-structural diversity relationships change across climate gradients.

Method: Forest biodiversity was measured for 11 NEON sites in the eastern United States (Fig. 1) using foliar trait maps produced from NEON hyperspectral data by Wang et al. 2020. A suite of structural diversity metrics describing the height, complexity, and density of forest vegetation was also calculated using concurrently collected NEON LiDAR data.

Result:

- The links between biodiversity and structure strongest at spatial scales of 500 meters or above for 14 of the 16 evaluated relationships (Fig. 2).
- Trait dispersion (spread) and richness (range) had the strongest relationships with structure and the relationships tended to be negative across scales.
- Precipitation seasonality was a strong predictor of the strength and shape of the relationships between evenness (degree of uniformity of traits) and structural diversity.

FOR FURTHER READING:

Coverdale, T.C., Davies, A.B., 2023. Unravelling the relationship between plant diversity and vegetation structural complexity: A review and theoretical framework. *J. Ecol.* 111, 1378–1395.
<https://doi.org/10.1111/1365-2745.14068>



Figure 1. Map of National Ecological Observatory network sites where structural-functional diversity relationships were assessed.

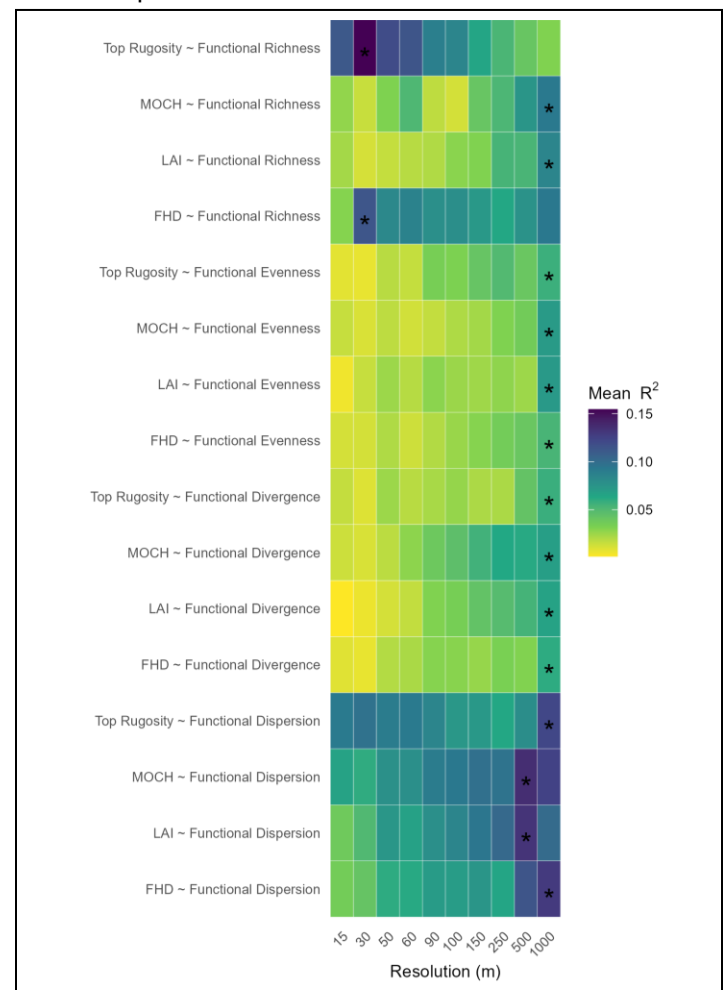


Figure 2. Comparison of relationship strength between structural diversity and functional diversity metrics across spatial scales.