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Biodiversity-Ecosystem Function Relationships Are Mediated by the Environment and Functional Trait Assembly

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There are numerous studies demonstrating that biodiversity should increase the strength of vital ecosystem functions (e.g., biomass production or pollination services). However, most studies manipulate species diversity by randomly assembling communities within small homogeneous environments. There is considerable debate though regarding the extent to which these biodiversity-effects scale up to natural, heterogeneous landscapes where most ecosystem management and restoration actions are targeted. Here, I asked what factors impact the strength of this relationship. Specifically, how is the biodiversity-ecosystem function relationship in naturally assembled plant communities is altered by environmental variation and the distribution of functional traits? I conducted this study in an Oak-Hickory forest landscape at the Tyson Research Center. I censused plant species composition, biomass, and functional traits in 90 1-m¬2 plots distributed across strong soil resource gradients in the forest. Using general linear models, I found species diversity increased productivity across all environments. However, with increasing environmental harshness there was a lesser effect of diversity on productivity. I also found that two components of functional diversity mediated the strength of this relationship. Functional divergence (the degree of niche differentiation among dominant species) increased the biodiversity effect whereas functional evenness (the degree to which species abundances are distributed in niche space) decreased the biodiversity effect. Ultimately, results from this study show 1) the importance of biodiversity for ecosystem functions demonstrated in homogenous, random assembly experiments applies to heterogeneous, naturally assembled communities; and 2) the strength of this relationship depends on both the environmental conditions and distribution of functional traits. These results have important implications for extending current theory to better predict how biotic homogenization and habitat loss will alter the functions of real-world ecosystems.