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Soil biotic diversity response to precipitation changes with implications for soil function recovery

Climate change has profoundly reshaped global biodiversity distributions and community assembly processes, with particularly strong impacts in precipitation-sensitive dryland ecosystems. Yet, how precipitation shifts influence plant and arthropod assembly processes—and how these effects cascade across trophic levels to shape multitrophic β diversity—remains poorly understood. To address this gap, we conducted a rainfall manipulation experiment ($\pm 20\%$, $\pm 40\%$, $\pm 60\%$) in a semiarid grassland of northern China, a region highly vulnerable to climatic variability. We examined community assembly processes and β -diversity patterns across three trophic levels: plants, herbivorous arthropods, and predatory arthropods. Our results reveal a precipitation threshold (~ 380 mm) at which plant community assembly shifts from deterministic to stochastic processes. In contrast, herbivorous and predatory arthropods consistently exhibited stochastic assembly, likely reflecting dispersal-driven buffering mechanisms. Importantly, we found a bottom-up linkage between plant and herbivore β diversity, supporting the “diversity begets diversity” hypothesis. However, this coupling weakened beyond the identified threshold, indicating precipitation-induced decoupling of trophic interactions. Together, these findings suggest that precipitation-driven ecological filtering in plants, combined with cascading effects on arthropods, may increase species turnover and reduce the predictability of community dynamics under wetter conditions. This work provides a critical foundation for developing biodiversity conservation strategies aimed at enhancing ecosystem resilience in the face of accelerating climate change.

Biography

Liu Rentao has been doing his postdoctoral studies from Universitat CREAF (UAB). He is the research professor of Ningxia University School of Ecology and Environment. He has published more than 52 papers in reputed journals and has been serving as an editorial board member of repute.