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# Diversity - stability relationship: from theory to natural communities

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## Abstract

The diversity-stability relationship is one of the most debated topics in ecology, but mostly using theoretical or experimental approaches. These approaches showed a positive effect of diversity on temporal stability and highlighted three mechanisms potentially involved: the overyielding, the variance and the covariance effects. They also looked at the effect of diversity on population stabilities, finding contrasting relationships. However, natural communities differ from theoretical or experimental ones as their composition is not random but depend on local conditions and perturbations. Here we investigate the diversity-stability relationship in such natural communities, looking at the mechanisms involved and how perturbations can affect this relationship. We analyzed the temporal stability over 8 years of 131 natural butterfly communities. We integrated data about landscape composition and habitat quality to estimate environmental perturbation levels. Our results indicate that diversity drives the stability of natural butterfly communities through a positive effect of species richness on population stability and a negative effect of phylogenetic diversity on population synchrony. Moreover, habitat degradation affects this relationship through a negative effect of urbanization on species richness and population stability, and a negative effect of croplands on phylogenetic diversity. As in theoretical and experimental systems, we found a global positive diversity-stability relationship in natural butterflies communities. Nonetheless, the positive relationship between diversity and population stability we found contrasts with previous theoretical and experimental works. Finally, our results highlight the need to integrate perturbations in the framework as they can affect the diversity-stability relationship in other way than only affecting species diversity.

**Keywords:** diversity, stability, butterflies, communities, landscape perturbations, synchrony

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