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A new perspective on 40 years of debate on the stability-complexity relationship

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Understanding the mechanisms responsible for the stability and persistence of natural communities is one of the greatest challenges in ecology. Robert May showed that contrary to intuition, complex randomly built communities are less likely to be stable than simpler ones. For four decades, ecologists have tried to isolate the non-random characteristics of natural communities that could explain how they persist despite their complexity. Surprisingly, few attempts have tried to test May's fundamental prediction and we still ignore if there is indeed a relationship between stability and complexity in nature. I will start with reporting a comparative stability analysis of 121 quantitative food webs sampled worldwide, from marine, freshwater and terrestrial habitats. The analysis reveals that complexity does not affect stability in natural food webs. Food web structure, which is far from random in real communities, reflects another form of complexity that influencing dramatically the stability of real communities. I then consider the impact of spatial dynamics on stability. I present a spatial extension to May's analysis of random ecosystem within the metaecosystem framework. I find that, contrary to May's expectation for local communities, diffusion in random metaecosystems stabilizes dynamics. I conclude that the occurrence of complex communities in nature is possible owing to their trophic structure and spatial dynamics. Even if May's approach was based on wrong assumptions and his prediction has been falsified, the theory he proposed is a powerful null model that greatly improved our understanding of the mechanisms promoting stability of natural ecosystems.

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