

Localization in Mutualistic Networks

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Despite much theoretical effort, the relationships between the nested architecture of the species interaction network, the robustness of mutualistic ecological communities, and the mechanisms ensuring the stability of ecological networks are still unclear. Until now, most studies on the stability of ecological communities have focused their attention on asymptotic resilience (time to return to the steady state after a small perturbation) or persistence (number of coexisting species at equilibrium), neglecting how perturbations propagate through the system. Here we develop a general theoretical framework to evaluate the relationship between architecture of the interaction networks and the impact of perturbations on mutualistic ecological communities by studying the phenomenon of localization, a measure describing the ability of the perturbation to propagate through the network. Localization depends on the topology of the species interaction networks, and it positively correlates with nestedness. We show that mutualistic ecological communities are localized systems, and that localization reduces perturbation propagation and attenuates its impact on species abundance. Furthermore, the observed localization increases with the size of the ecological communities, highlighting a trade-off between the asymptotic resilience of the system and the attenuation of perturbations. Our results provide a different perspective on the interplay between the topology of the species interaction network and the size and resilience of ecological communities.