Network structure drives biodiversity in mutualistic systems.

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The origin and the consequences of the nested structure of mutualistic ecosystems as well as the pertinent characterisation of such ordering are a matter of strong debate in the ecological community. The relationship between the structure of mutualistic ecosystems and the dynamics that led to this structure is still an open problem. In the seminal paper of May[1], the ecosystem is described by a dynamical linear model, with a random matrix interaction. His results show that a large ecosystem with high conectivity (the connectivity being associated to the complexity of the system) is unstable. Since then, special attention has been paid to the structure of the interaction matrix. Bastolla et. al [2] study a population dynamics model that includes both types of interactions. All interactions are treated in mean-field approach except for the case of weak mutualism, where a more realistic mutualistic term is built based on natural bipartite interaction matrices. They conclude that the nested character of the interactions minimizes competition allowing for an increase of biodiversity. A very recent article [3] discusses the importance of structural stability studies of mutualistic ecosystems. As the parametrization of the studied models is quite arbitrary, it becomes crucial to assess how the obtained results behave face to the variation of these parameters.

In this work we investigate the influence of the network structure on the persistence of species of a mutualistic ecosystem. We study a non-linear population dynamics model where we take into account the structure of interactions both, in mutualistic and competition terms. In fact, the observed networks contain more information than just the plant-pollinator interactions. One can obtain two square matrices by projecting the bipartite matrix on the subspace of animals or plants. An element of these matrices represents the number of counterparts shared by any two given species of the same guild. This information can be then used to model the competition term beyond the mean-field approach. We study how the obtained steady states vary with the nestedness

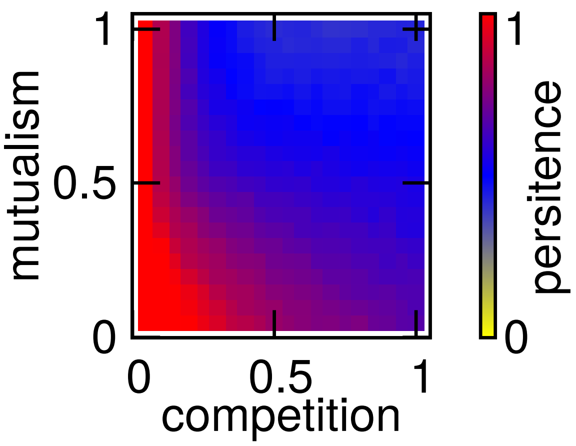

Figure 1: Persistence of species as a function of the interspecific competition and mutualistic parameters. Interactions are obtained from of real network M-PL-005. Each point represents the fraction of species corresponding to the steady state of the system evolved with different parameters.

of the system while controlling or not for degree distributions. Our results show the existence of a trade-off between mutualism and competition, so that the largest biodiversity is achieved with a non-trivial combination of both mechanisms.

References

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