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Cooperation, collapse and resilience: ecological and evolutionary consequences of heterogeneous metapopulation structure ANURAG LIMDI, Indian Institute of Science, Massachusetts Institute of Technology, ALFONSO PEREZ-ESCUDERO, Massachusetts Institute of Technology, AMING LI, Northeastern University, JEFF GORE, Massachusetts Institute of Technology —
While negative frequency and density dependent selection and population structure are used to explain the evolution of cooperation separately, their combined effect remains unexplored. Here, we consider the effect of heterogeneity of metapopulations linked by migration in a yeast cooperator-defector system. We discover that asymmetric migration on star networks, coupled with density dependent selection, can double the cooperator fraction compared to isolated nodes and fully connected networks. Migration reduces population density on the side nodes which makes star networks more prone to collapse in challenging environments than isolated populations. Unexpectedly, we find that star networks have greater resilience to a temporary salt shock than isolated nodes. This can be reconciled by noting that the level of permanent stress that the network can withstand is influenced by side nodes which are the most vulnerable parts of the network. In contrast, the ability to recover from temporary shocks is defined by the central node (which has a higher density and cooperator fraction than isolated nodes), because it can reseed the side nodes and rescue the whole network. Our findings highlight that ecological communities respond differently to constantly and transiently harsh environments.

Anurag Limdi
Indian Institute of Science

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