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Competition and cooperation in one-dimensional stepping stone models KIRILL KOROLEV, Massachusetts Institute of Technology, DAVID NELSON, Harvard University — Mutualism and cooperation are major biological forces sustaining ecosystems and enabling complex evolutionary adaptations. Although spatial degrees of freedom and number fluctuations often significantly affect evolutionary dynamics, their effects on mutualism are not fully understood. We show that, even when mutualism confers a distinct selective advantage, it persists only in populations with high density and frequent migrations. When these parameters are reduced, number fluctuations lead to the local extinctions of one of the species, segregating the species in space and decreasing the size of regions where cooperation occurs. The segregated and mutualistic states are separated by a second order nonequilibrium phase transition. Generically, this transition is in the universality class of directed percolation (DP), but the phase diagram is strongly influenced by an exceptional symmetric directed percolation (DP2) transition. This influence is manifested in a strong increase in the resilience to number fluctuations of symmetric mutualism, when organisms benefit equally from interacting.

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