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Stochastic predator-prey models: spatial variability enhances species fitness[1]

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It is now well understood that including spatial structure and stochastic noise in models for predator-prey interactions invalidates the classical deterministic Lotka-Volterra picture of neutral population cycles. In contrast, stochastic models yield long-lived, but ultimately decaying erratic population oscillations, which can be understood through a resonant amplification mechanism for density fluctuations. Simulations of spatial stochastic predator-prey systems yield striking complex spatio-temporal structures. These spreading activity fronts induce persistent correlations between predators and prey. Here, we address the influence of spatially varying reaction rates on a stochastic two-species Lotka-Volterra lattice model. The effects of this quenched randomness on population densities, transient oscillations, spatial correlations, and invasion fronts are investigated through Monte Carlo simulations. We find that spatial variability in the predation rate results in more localized activity patches. Population fluctuations in rare favorable regions in turn cause a remarkable increase in the asymptotic population densities of both predators and prey, and also lead to accelerated front propagation.

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