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Coevolution of Habitat Use in Stochastic Environments.

Abstract: Species live and interact in landscapes where enviornmental conditions vary both in time and space. In the face of this spatial-temporal heterogeneity, species may co-evolve their habitat choices which determine their spatial distributions. To understand this coevolution, I present an analysis of a general class of stochastic Lotka-Volterra models that account for space implicitly. For these equations, a (stochastic) coevolutionarily stable strategy (coESS) is a set of habitat choice strategies for each species that, with high probability, resists invasion attempts from mutant subpopulations utilizing other habitat choice strategies. We show that the coESS is characterized by a system of second-order equations. This characterization implies that the stochastic per-capita growth rates are negative in all occupied patches for all species despite all of the species coexisting. Applying this characterization to the coevolution of habitat-choice of competitors and predator-prey systems identifies under what environmental conditions, natural selection excorcises ``the ghost of competition past'' and generates enemy-free and victimless habitats. Collectively, these results highlight the importance of temporal fluctuations, spatial heterogeneity and species interactions on the evolution of species' spatial distributions.