Pathogen evolution in switching environments: a hybrid dynamical system approach

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We propose a hybrid dynamical system approach to model the evolution of a pathogen that experiences different selective pressures according to a stochastic process. In every environment, the evolution of the pathogen is described by a version of the Fisher-Haldane-Wright equation while the switching between environments follows a Markov jump process. We investigate how the qualitative behavior of a simple single-host deterministic system changes when the stochastic switching process is added. In particular, we study the stability in probability of monomorphic equilibria. We prove that in a “constantly” fluctuating environment, the genotype with the highest mean fitness is asymptotically stable in probability while all others are unstable in probability. However, if the probability of host switching depends on the genotype composition of the population, polymorphism can be stably maintained.

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