# Pattern Formation in a Patch Occupancy Metapopulation Model: a Cellular Automata Approach

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**Abstract**

The explicit consideration of space in ecological research is of paramount importance to understand the structure and functioning of ecological systems. In this paper we develop a simple spatially explicit metapopulation model in which colonization is constant and independent of the number of occupied patches (i.e. propagule-rain effect, Gotelli, 1991). Extinction, on the other hand, is modelled as a stochastic process whose intensity depends on the number of occupied patches in the neighborhood of each focal patch. Our model is the CA counterpart of two classical patch occupancy metapopulation models. We analytically prove this by showing that our CA converges to the differential equation in the mean-field approximation. The asymptotic behaviour of the system, expressed as the proportion of occupied patches, agrees with the equilibrium proportion of patches derived by using ODEs. In both models, the existence of a rescue-effect increases the range of extinction and colonization parameters over which the system attains complete occupancy of patches. However, in our model this result is strongly influenced by the degree of coupling among patches and is apparent only for local interactions. With local interactions and particular parameter values of colonization and extinction, self-organized spatio-temporal patterns emerge with a fractal-like clustering, even though the environment is spatially homogeneous. Our results point out that the importance of being spatial and discrete (Durrett & Levin, 1994a) in our model is a result of local interactions.