HIV infection, increases TB incidence. Besides, we also observed that exogenous reinfection may also play an important role in TB epidemics, because it is capable of sustaining TB even when the basic reproductive number R0 ¡ 1.

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Colored-noise-induced discontinuous transitions in symbiotic ecosystems

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One of the key issues in ecology is how enviromental fluctuations and species interactions determine variability in population densities [1]. The essential role of environmental fluctuations has recently been recognized and the noise-induced effects on population dynamics have been the subject of intense theoretical investigations [2].

Inspired by the fact that external multiplicative noise can induce multistability as well as first-order phase transitions in some complex systems, the authors of [3] have investigated whether the catastrophic shifts occurring in ecosystems could be sometimes regarded as induced by multiplicative colored noise.

We consider a broad class of N-species Lotka-Volterra models of symbiotic ecological systems with the generalized Verhulst self-regulation mechanism. The effect of fluctuating environment on the carrying capacity of a population is taken into account as dichotomous noise. A symbiotic ecosystem is studied by means of the Lotka-Volterra stochastic model, using the generalized Verhulst self-regulation. Relying on the mean-field theory, an exact self-consistency equation for stationary states is derived. In some cases the mean field exhibits hysteresis as a function of noise parameters. It is established that random interactions with the environment can cause discontinuous transitions. The dependence of the critical coupling strengths on the noise parameters is found and illustrated by phase diagrams. Predictions from the mean-field theory are compared with the results of numerical simulations.

Our major result is that, in the case of symbiotic ecological systems (or metapopulations) with the generalized Verhulst self-regulation, colored fluctuations of the environment can cause abrupt transitions of mean population densities, even if the system is monostable in the absence of noise. Therefore, an increase of noise amplitude or a decrease of noise correlation time can under certain conditions cause a catastrophic fall in the size of the populations. Such results provide a possible scenario for catastrophic shifts of population sizes observed in nature.

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Discrete and Continuous State Population Models in a Noisy World

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Simple ecological models operate mostly with population densities using continuous variables. However, in reality densities could not change continuously, since the population itself consists of integer numbers of individuals. At first sight this