Coloured-noise-induced Hopf bifurcations in predator-prey communities

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One of the key issues in ecology is how environmental fluctuations and species interactions determine the oscillations in population size. Recently, the influence of noise on oscillatory motion in nonlinear systems has been the topic of a number of physical investigations.

A broad class of ratio-dependent predator-prey stochastic models with one predator and N preys is considered. The effect of fluctuating environment on the carrying capacities of prey-populations is taken into account as a coloured noise. In the framework of the mean-field theory approximate self-consistency equations for mean prey-populations density and for predator-population density are derived. In some cases the mean field exhibits Hopf bifurcations as a function of noise correlation time. The corresponding transitions are found to be reentrant, e.g., the periodic orbit appears above a critical value of noise correlation time, but disappears again at a higher value of the noise correlation time. The nonmonotonous dependence of the critical control parameter on the noise correlation time is found and the conditions for the occurrence of Hopf bifurcations are presented.

Our results provide a possible scenario for noise-induced transitions between oscillatory regime and equilibrium state of population sizes observed in nature.

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