Noise Enhance Coexistence in Population Competition Models with Multiple Attractors

Bernard Cazelles[1] .

Since May's seminal papers much attention has been focused on the qualitative properties of nonlinear population dynamics. Another emergent concept appeared this last couple of years, the concept of multiple attractors in which several complex asymptotic attractors coexist. In numerous cases, dynamics with multiple attractors also sensitively depends on initial conditions. In this case, the unpredictability is greatly exacerbated because one cannot make predictions neither at a microscopic level owing the chaotic nature of the dynamics, nor at a macroscopic level because small variations in initial conditions induce a switch between the different coexisting attractors.

The purpose of this work is to show the advantages of the multiple attractors behavior with complex attraction basins in a population model. The model employed is the Franke-Yakubu' model of competition between 2 species, x and y. The dynamics of the model contains 2 attractors. In the first one the 2 species coexist, and in the second there is extinction of the y species. For value in a particular region of the parameter space, the extinction of the y species sensitively depends on the values of initial conditions. Furthermore the boundary between the initial conditions leading to each of the 2 attractors is complex and fractal. With this kind of fractal attraction basins, it becomes impossible to predict the asymptotic dynamics of the 2 species. But in presence of noise, the coexistence of the 2 species is greatly enhanced. Noise can stabilize the community dynamics on the coexistence attractor and, as in Stochastic Resonance, there is some optimal level of noise that enhances this coexistence.

[1]Laboratoire d'Ecologie, CNRS UMR 7625, Université Pierre et Marie Curie, 7 quai Saint Bernard, CC 237, 75252 Paris, France (e-mail: bcazelle@snv.jussieu.fr).

Environmental noise is an important component of population dynamics. This complex behavior, induced by noise, has far-reaching ecological consequences that will discuss in the context of conservation biology.