Multiple attractors and long transients in metapopulations with Allee effect

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Metapopulation models with Allee effects give insight about the interplay between local bistability and dispersal. In this context, the rescue effect was described. It states that a subpopulation that falls under the Allee threshold is rescued from extinction by migration from the other patch. Thus, local populations that are linked by dispersal are more abundant and less susceptible to extinction than isolated populations. However, little attention has been devoted to the case in discrete time where local dynamics can be chaotic. Depending on the parameters, not only small populations are at risk but almost every initial condition can lead to "essential extinction". Hence, the correlation between abundance and extinction risk is not trivial.

We present the analysis of a discrete-time metapopulation model of a single species with a strong Allee effect and overcompensation. It turns out that the system can have up to six coexisting attractors. Moreover, dispersal can protect the metapopulation from essential extinction due to two mechanisms. In the case of weak coupling, both patches can show different dynamics and a state where one subpopulation density lies above and the other one below the Allee threshold is stable. Strong coupling, on the other hand, enables both populations to persist above the Allee threshold when dispersal dampens the amplitude of local dynamics. For intermediate dispersal essential extinction is indispensable.

Finally, the importance of the time scale is emphasized. In the surrounding of boundary crises, long transients can occur and various ghost attractors appear before the eventual attractor is reached.