The role of asymmetries in rock-paper-scissors biodiversity models

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The maintenance of biodiversity is a long standing puzzle in ecology. It is a classical result that if the interactions of the species in an ecosystem are chosen in a random way, then complex ecosystems can't sustain themselves, meaning that the structure of the interactions between the species must be a central component on the preservation of biodiversity and on the stability of ecosystems. The rock-paper-scissors model is one of the paradigmatic models that study how biodiversity is maintained. In this model 3 species dominate each other in a cyclic way (mimicking a trophic cycle), that is, rock dominates scissors, that dominates paper, that dominates rock. In the original version of this model, this dominance obeys a Z_3 symmetry, in the sense that the strength of dominance is always the same. In this work, we break this symmetry, studying the effects of the addition of an asymmetry parameter. In the usual model, in a two dimensional lattice, the species distribute themselves according to spiral patterns, that can be explained by the complex Landau-Guinzburg equation. With the addition of asymmetry, new spatial patterns appear during the transient and the system either ends in a state with spirals, similar to the ones of the original model, or in a state where unstable spatial patterns dominate or in a state where only one species survives (and biodiversity is lost).