The Moran-effect in nonlinear systems

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Field studies of feral sheep populations on two distinct islands of the St. Kilda archipelago revealed strong correlations due to environmental noise ([2],[3],[4]). To further investigate this phenomenon on theoretical ground, we ask whether correlated noise is able to synchronize two spatially separated and not coupled populations. For a linear system the Moran [1] effect states that the population correlation equals the noise correlation. However real systems often exhibit highly nonlinear behaviour. Thus we ask if the Moran effect persists in these kind of systems or if the population correlation may even be enhanced due to nonlinearity. As a first step to answer these questions, we model the population dynamics via the nonlinear logistic map. An integral equation allows for a numerical calculation of the stationary density distribution. We show analytically that the population correlation in the fixed point regime is always smaller than the noise correlation. In the period 2 regime a Markov model explains qualitatively the main dynamical characteristics. Our theoretical results reproduce the essential features of the experimental data.

References

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