Extinction of cellular organisms in the presence of multiple hostile and favorable environments

Niraj Kumar and V. M. Kenkre

Consortium of the Americas for Interdisciplinary science and Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico 87131

We observe a phase transition in the population dynamics of cellular organisms in the presence of periodically placed hostile and favorable regions. The hostile domain does not present infinitely harsh environment and, thus, allows penetration of population into these domains. The evolution is governed by the Fisher equation. We observe that, the system undergoes a phase transition at a critical length of the favorable region for a given length of the hostile region. This critical length separates two different phases: if the length of the favorable region exceeds the critical length, the population survives, otherwise, the population undergoes complete extinction. Using a simple mathematical analysis, we find exact analytic expressions for the critical length. Explicit prescriptions for conducting relevant experiments for bacteria in a petri dish are provided.