PATCHY, NOT PATCHY, OR HOW MUCH PATCHY? CLASSIFICATION OF SPATIAL PATTERNS APPEARING IN A MODEL OF BIOLOGICAL INVASION

Natalia Petrovskaya[1], Sergei Petrovskii[2] and Wenxin Zhang[1]

[1] School of Mathematics, University of Birmingham, Birmingham, UK
[2] Department of Mathematics, University of Leicester, Leicester, UK

Abstract

Good understanding of spatio-temporal patterns of species spread during biological invasion is needed for efficient monitoring and control of harmful alien pests. Various growth-dispersal-type models of population dynamics predict that invasive species spread can follow two qualitatively different scenarios such as the propagation of a continuous population front and the 'no-front' patchy invasion. Distinguishing between these two patterns of spread is important, in particular because the patchy invasion poses a much greater challenge for monitoring and control. However, a mathematical theory of the patchy invasion is missing and it remains unclear what are the restrictions on parameter values and how much different this dynamical regime is from the continuous front propagation. In this paper, we address these issues in terms of a biologically meaningful mathematical model consisting of two coupled integral-difference equations. We show that the relevant domain of the parameter space has a complex intermittent structure. We also suggest a criterion that can be used to distinguish between the patchy invasion and the continuous front propagation: the patchy-invasion spatial pattern is shown to be much more sensitive to the cutoff at low densities.