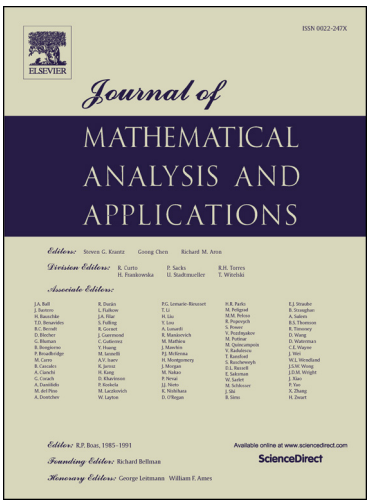
Accepted Manuscript



The Diffusive Logistic Equation on Periodically Evolving Domains

Dan-Hua Jiang, Zhi-Cheng Wang

PII: S0022-247X(17)30816-8
DOI: http://dx.doi.org/10.1016/j.jmaa.2017.08.059
Reference: YJMAA 21666

To appear in: *Journal of Mathematical Analysis and Applications*

Received date: 3 December 2016

Please cite this article in press as: D.-H. Jiang, Z.-C. Wang, The Diffusive Logistic Equation on Periodically Evolving Domains, *J. Math. Anal. Appl.* (2017), http://dx.doi.org/10.1016/j.jmaa.2017.08.059

The Diffusive Logistic Equation on Periodically Evolving Domains

Dan-Hua Jiang, Zhi-Cheng Wang *
School of Mathematics and Statistics, Lanzhou University,
Lanzhou, Gansu 730000, People's Republic of China

Abstract

A diffusive logistic equation on n-dimensional periodically and isotropically evolving domains is investigated. We first derive the model and present the eigenvalue problem on evolving domains. Then we prove that the species persists if the diffusion rate d is below the critical value $\underline{D}_0$, while the species become extinct if it is above the critical value $\overline{D}_0$. Finally, we analyze the effect of domain evolution rate on the persistence of a species. Precisely, it depends on the average value $\overline{\rho^{-2}}$, where $\rho(t)$ is the domain evolution rate, and $\overline{\rho^{-2}} = \frac{1}{T}\int_0^T \frac{1}{\rho^2(t)}dt$. If $\overline{\rho^{-2}} > 1$, the periodical domain evolution has a negative effect on the persistence of a species. If $\overline{\rho^{-2}} < 1$, the periodical domain evolution has a positive effect on the persistence of a species. If $\overline{\rho^{-2}} = 1$, the periodical domain evolution has no effect on the persistence of a species. Numerical simulations are also presented to illustrate the analytical results.

Keywords: Logistic equation, evolving domains, persistence and extinction
AMS Subject Classification (2010): 35K57, 35K55, 37C60, 92D25

1 Introduction

A fundamental goal of theoretical ecology is to understand how the interactions of individual organisms with each other and with the environment determine the distribution of populations and the structure of communities. In recent decades the role of spatial effects in maintaining biodiversity has received a great deal of attention. One way to try to understand how spatial effects such as habitat influence populations and communities is by using mathematical models [8, 35]. Reaction-diffusion models provide a way to translate

*The correspondence author (E-mail address: wangzhch@lzu.edu.cn).