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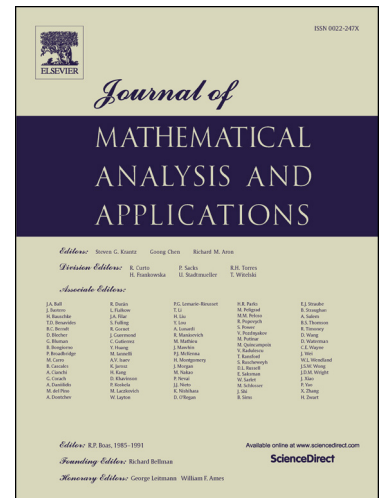
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Dynamics of a Diffusion Reaction Prey-Predator Model with Delay in Prey: Effects of Delay and Spatial Components

Feng Rao¹, Carlos Castillo-Chavez², Yun Kang³.

Abstract

We study the complex dynamics of a Monod-Haldane-type predator-prey interaction model that incorporates: (1) A constant time delay in the prey growth; and (2) diffusion in both prey and predator. We provide the rigorous results of our system including the asymptotic stability of a positive equilibrium; Hopf bifurcation; and the direction of Hopf bifurcation and the stability of bifurcated periodic solutions. We also perform numerical simulations on the effects of diffusion or/and delay when the corresponding ODE model has either a unique interior equilibrium with two interior attractors or two interior equilibria. Our theoretical and numerical results show that diffusion can either stabilize or destabilize the system; large delay could destabilize the system; and the combination of diffusion and delay could intensify the instability of the system. Moreover, when the corresponding ODE system has two interior equilibria, diffusion or time delay in prey or both could lead to the extinction of predator. Our results may provide us useful biological insights on population managements for prey-predator interaction systems.

Key words: predator-prey system; time delay; diffusion-reaction; Hopf bifurcation; Turing instability

1. Introduction

Dynamics of prey-predator systems has been an important research theme in ecology. It is well known that prey-predator interaction is not only one of the basic interspecies relations for ecological and social systems, but also the basic block of more complicated food chains, food

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